DOCUMENT RESUME

ED 243 696 SE 044 467

AUTHOR	Sadowski, Barbara, Ed.
TITLE	An Annotated Bibliography Relating to the Diagnostic and Prescriptive Instruction of Mathematics. Volume 2.
INSTITUTION	Research Council for Diagnostic and Prescriptive Mathematics, Kent, OH.
REPORT NO	ISBN-0-940466-02-9
PUB DATE	82
NOTE	76p.; For a related document, see SE 044 466.
AVAILABLE FROM	Research Council for Diagnostic and Prescriptive Mathematics, 441 Beryl Drive, Kent, OH 44240.
PUB TYPE	Reference Materials - Bibliographies (131)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	Annotated Bibliographies; *Diagnostic Teaching; Educational Research; *Elementary School Mathematics; Learning Problems; *Mathematics Education; *Remedial Mathematics; *Teaching Methods
IDENTIFIERS	Mathematics Education Research

ABSTRACT

This second annotated bibliography provides references to articles, books, dissertations, and presentations published since the first bibliography appeared in 1979. The focus is again on how children learn mathematics and on diagnostic and remedial techniques for teaching mathematics, particularly at the elementary school level. Many research reports on diagnostic and prescriptive mathematics are included. (MNS)

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Research Council
for
Diagnostic and Prescriptive Mathematics

AN ANNOTATED BIBLIOGRAPHY RELATING TO THE DIAGNOSTIC AND PRESCRIPTIVE INSTRUCTION OF MATHEMATICS VOLUME 2

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Edited by

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University of Houston
Houston, Texas
1981

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AN ANNOTATED BIBLIOGRAPHY RELATING TO THE DIAGNOSTIC AND PRESCRIPTIVE INSTRUCTION OF MATHEMATICS VOLUME 2

EDITED BY

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HOUSTON, TEXAS
1981

PRODUCTION EDITOR: DON BERNARD, UNIVERSITY OF FLORIDA

PRINTING AND DISTRIBUTION: BARBARA MOSES, BOWLING GREEN STATE UNIVERSITY
JAMES HEDDENS, KENT STATE UNIVERSITY

VICE PRESIDENT OF DISSEMINATION: LINDA OLDAKER GEMMILL, ARIZONA STATE UNIVERSITY

PUBLISHED BY THE RESEARCH COUNCIL FOR DIAGNOSTIC AND PRESCRIPTIVE MATHEMATICS
441 BERYL DRIVE
KENT, OHIO 44240

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DIAGNOSTIC AND PRESCRIPTIVE MATHEMATICS
FIRST PRINTING, JANUARY 1982, AT BOWLING GREEN, OHIO

PRINTED IN THE UNITED STATES OF AMERICA

ISBN-0-940466-02-9
LIBRARY OF CONGRESS NUMBER

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ACKNOWLEDGMENTS

The second volume of the RCDPM bibliography is the result of contributions made by two groups of people. First the members who wrote the annotations for books and dissertations which are included here deserve a special thank you beyond that extended in the acknowledgment to the first volume of the bibliography.

The second group are those RCDPM members who annotated the articles, books, dissertations and presentations published since the first volume of the bibliography. A thank you is extended to Roslynn Seidenstein, Audrey Leef, Francis (Skip) Fennell, Katherine Hodgin, Gayle Johnson, Sharon Young, and graduate students at the University of Maryland and University of Houston who contributed a great deal of time and effort to this project. I am especially indebted to two doctoral students at the University of Houston, Valeria Amburgey and Dell Simon, for countless hours spent assisting with the numerous tasks associated with the preparation of the bibliography manuscript. To them, my sincerest thanks.

B.R.S.

Adams, S., Ellis, L., & Beeson, B.F. Teaching mathematics with emphasis on the diagnotic approach. New York: Harper and Row, 1977.

A book that attempts to serve as a guide to diagnostic teaching procedures that can be applied to elementary school classrooms with a chapter on organizing a diagnostic approach to teaching. The contents of the book include whole number operations, fractions, problem solving, measurement and geometry and special topics such as graphs and elementary statistics.

(W. Speer)

Aldridge, W.S. Effects of electronic calculators on achievement of middle school remedial mathematics students. Dissertation Abstracts International, 1976, 37, 4078A.

Study to determine difference in achievement of remedial math students with and without access to electronic calculator. Computational Skills Developmental Kit and Basic Skills in Arithmetic Test used. Implication that remedial eighth grade students may profit from calculator aid and purchase of equipment justified.

Alexander, D.W. A clinical diagnostic investigation of fundamental reasons for conceptual difficulties with algebra. Dissertation Abstracts International, 1977, 39, 764A.

Applied the interview technique to the study of students' algebraic thinking as they began formal study of algebra in the ninth grade. Twelve students varying in mathematical ability were used in the study. It appeared that success in algebra, as measured by school results, was more related to fluency in the use of imagery than insightful understanding of the material.

(L. Callahan)

Altinger, J. Atroversion in developmental college algebra. Focus on Learning Problems in Mathematics, 1980, 2(3), 57-60.

The author contends that students who are enrolled in a developmental college algebra course may have various disabilities, but all suffer from atroversion. He describes atroversion as a combination of mental atrophy (emaciation; wasting away) and an extreme aversion (dislike; opposition; fear; anxiety) for math. A favorable prognosis for this condition is possible if the teacher realizes the similarity of the mind to a muscle. Future articles will discuss techniques for think therapy and memory therapy in the class mentioned above.

(V. Amburgey)

Arthur, L.E. Diagnosis of disabilities in arithmetic essentials. Mathematics Teacher, 1950, 43, 197-202.

Diagnosis of disabilities in arithmetic essentials was designed specifically to test high school freshmen on the 30 essentials listed by the committee on

essentials, 1943. The final form of the test was administered to 210 and 199 freshmen in Riverside-Brookfield High School on September 1946 and 1947 respectively. The result showed that much remedial teaching was necessary before many of the pupils could be expected to perform satisfactorily the operations called for by the essentials tested.

(O. Inuenwi)

Ashcraft, M.H. & Stazyk, E.H. Mental arithmetic: An information process tutorial. Focus on Learning Problems in Mathematics, 1979, 1, 43-59.
This article gives an analysis of information processing in human as compared to that in a computer by diagnosing processes of mental arithmetic in children and in adults using a cognitive model. It gives implications and speculations about reaction time to a visually presented arithmetic problem, errors of arithmetic performance and the effectiveness of different instructional methods.

(S. Moss)

Ashlock, R.B. Error patterns in computation: A semi-programmed approach. Columbus, Ohio: Charles E. Merrill Publishing Co., 1976.
Designed for teachers to help children learn to improve their computation skills. Using examples taken from children's classroom work, the author provides a step-by-step method for learning to identify and analyze error patterns; he then describes instructional activities that have helped many children overcome each of these difficulties. For each set of examples of faulty computation, the reader can: (a) try to find the error pattern, (b) check to see if the diagnosis was correct, (c) receive feedback on suggestions for corrective instruction. The author stresses the inherent dependence of computational skill on the understanding of basic mathematical concepts.

(Baxter and Graeber)

Ashlock, R.B. & Welch, R.C. A test of understandings of selected properties of a number system: Primary form. Bulletin of the School of Education Indiana University, 1966, 42, (2).
A test of understandings of selected properties of a number system was developed for use with first and second graders. This is a group or individual test with no time limit. Data collected includes review of related research, procedures used, findings and results, conclusions, and recommendations. There is an extensive bibliograpy and several appendices, including the test itself and directions. A panel of experts conclude that this test has a relatively high degree of validity and reliability.

(L.J. Raivel)

Ashlock, R.B., Wilson, J., and Hutchings, B. Identifying and describing the remedial mathematics student in Mathematics Education Information Report. Ohio State University, ERIC Center for Science, Mathematics,

and Environmental Education, December, 1976, p. 1-19.
The authors discuss first a definition of the remedial mathematics student. The use of a "discrepancy score" is defended. A distinction is made between developmental needs (slow learners) and remedial needs (a selective deficiency in math). A Math Clinic is described. It would have a diagnostic section, a remedial section, and a cognitive research section. The functions of each are described and two organizational charts are included. Selection of children for this clinic is discussed. For gross selection achievement test scores and discrepancy scores can be utilized. Instruments and procedures are also used to consider these factors accounting for mathematics difficulty: subject matter, instructional, learner-organismic, and environmental.

(L.J. Raivel)

Battista, Michael. Interrelationships between problem solving ability, right hemisphere processing facility and mathematics learning. Focus on Learning Problems in Mathematics, 1980, 2(1), 53-60.
Students enrolled in college geometry, geometry for elementary and middle school teachers, college algebra, and number systems courses were tested on problem solving and spatial visualization. The spatial visualization test that was used has already been shown to be right hemisphere activities. The results indicate that problem solving and right hemisphere processing are related and both are related to success in mathematics.

(V. Amburgey)

Baur, G.R. & George, L.O. Identification and remediation of learning difficulties. In Helping Children Learn Mathematics. Menlo Park, California: Cummings Publishing Co., 1976.
The key to correcting a child's learning difficulties in mathematics is the early and proper identification of the difficulties. The task is not an easy one but will prove to be worth the time and effort. Once the difficulties have been identified, appropriate remediation procedures, including the use of the concrete-to-abstract continuum, may be devloped to correct the found difficulties.
A good technique which may be used by the classroom teacher involves a four-step process: 1) determine the exact nature of the error(s), 2) attempt to determine the cause(s) of the error(s), 3) determine appropriate level (concrete, semi- concrete, or abstract) for remediation procedures, and 4) plan appropriate remediation strategy(ies). A helpful addition to this technique is to look for patterns in the errors made by the child.

(G. Baur and D. Pigford)

Behr, M.J. & Sowder, L. Disadvantaged college students and methods of solving equations; an exploratory study. Focus on Learning Problems in Mathematics, 1980, 2(3), 49-55.
This study investigated the use of two methods of instruction, "cover up" &

"flow chart", for equation solving in special mathematics courses designed for university students with a generally poor academic background. Other factors that were also considered included the concept of field dependence/independence as aptitude and the use of a balance beam as a post organizer. The results did not significantly support the contention that students, who are low achievers, benefited from a highly structured method of instruction ("flow chart"). However, when tests were evaluated for use of procedure criterion, the "flow chart" method proved to be more effective.

(V. Amburgey)

Ben-Jacob, M.G. Innovative mathematics for the new decade: strategic methods of mathematics pedagogy. Focus on Learning Problems in Mathematics, 1981, 3(1), 5-11.

This article presents an algorithm for multiplying two numbers using only addition and multiplication by ten, through the construction of a Magic Number Chart. The use of this nonstandard algorithm is related to the methodology of Alan Natapoff called Strategic Methods.

(D. Simon)

Benz, H.E. Diagnosis in arithmetic. Journal of Educational Research, 1927, 15, 140-141.

A classroom procedure which is a method consisting of identifying those problems in which as many as half the pupils make errors and then analyzing the arithmetical processes which are needed in these problems. The suggestion is to begin instruction on the process which caused the greatest number of errors.

(B. Sadowski)

Berliner, D.C. Allocated time, engaged time and academic learning time in elementary school mathematics instruction. Focus on Learning Problems in Mathematics, 1980, 2(2), 27-39.

This study investigates the variability of allocated time, engaged time, and academic learning time for mathematics in four second grade classes and four fifth grade classes across several content areas. Academic learning time is defined as a variable that includes "accrued engaged time in a particular content area with materials that are of an easy level of difficulty." The between class differences in these variables seem to account for the variance in mathematics achievement.

(V. Amburgey)

Blankenship, W.L. A comparison of the effects of two mathematics programs upon selected fifth, sixth, seventh and eighth grade remedial mathematics students. Dissertation Abstracts International. 1976, 37, 2035A.

Attempt to determine if individualized small group attention with special materials for remedial students is more effective in knowledge gain than remedial students in subgroups of regular math class. Areas of computation, concepts, problem solving and total composite math involved.

Clinical approach stressed. Metropolitan Achievement Test and Otis-Lennon Mental Ability Test used. Gain was significant in both individualized and class groups when remediation was designed for their needs.

Bowman, D. G. A basic mathematics diagnostic instrument. Dissertation Abstracts International, 1976, 36, 7260A.

Numeration, math operations, problem solving, and elementary algebra involved in a diagnostic test of basic math for community college use. Format consists of slide-tape presentation and multiple-choice answers. Estimated reliability and professor evaluation from four colleges included.

Brennan, A.H. & Dunlap, W.P. Which children have learning disabilities in mathematics? Focus on Learning Problems in Mathematics, 1980, 2(2), 9-14.

The authors discuss the use of expectancy formulas in mathematics in order to identify children who may have learning disabilities. The formulas used were the same as the reading expectancy formulas.

(V. Amburgey)

Brown, J.S. & Burton, R.R. Diagnostic models for procedural bugs in basic mathematical skills. Cognitive Science, 1978, 2, 155-192.

A report on a new diagnostic modeling system for automatically synthesizing a deep-structure model of a student's misconceptions or bugs in his basic mathematical skills provides a mechanism for explaining why a student in making a mistake as opposed to simply identifying the mistake. The four sections of the report include (1) examples of the problems that must be handled by a diagnostic model, (2) a procedural network as a general framework for representing the knowledge underlying the skill, (3) a discussion of pedagogical issues that have emerged from the use of diagnostic models and (4) the use of an executable network as a tool for automatically diagnosing student behavior, for generating diagnostic tests, and for judging the diagnostic quality of a given exam.

(B. Sadowski)

Brown, J.S., Burton, R.R., Hausmann, C., Goldstein, I., Huggins, B., and Miller, M. Aspects of a theory for automated student modelling. U.S. Department of Commerce, Government Documents, AD/AO43-6271, May, 1977.

Brown et. al. investigated the effectiveness of using BUGGY, a computer error analysis program, to train preservice teachers in error analysis of simple arithmetic computations. Preservice teachers from Lesley College volunteered as subjects and were subsequently exposed to BUGGY for approximately one and a half hours.

An error analysis test which contained examples of both constant and random errors was used for assessment of all subjects. Data analysis indicated that the subjects significantly improved their skill in detecting

patterns of errors as a result of their work with BUGGY. The preservice teachers all reported the training to be worthwhile.

(S.L. Young)

Brownell, W.A. Remedial cases in arithmetic. Peabody Journal of Education, 1929, 7, 100-107.

A description of one-to-one diagnosis with a child in which the pupil is required to compute the examples aloud, and reveal to the examiner the processes or procedures he employs in dealing with numbers. The examiner supplements such data by questioning the pupil in detail concerning any procedures which do not seem to have been fully reported by the pupil.

(B. Sadowski)

Brownell, W.A. & Watson, B. Comparative worth of two diagnostic techniques in arithmetic. Journal of Educational Research, 1936, 29, 664-676.

An investigation of the reliability and validity of prescriptions derived from error analysis of fraction computation and from interviews conducted with the child. The think-aloud procedure was followed in the interview. The prescriptions from the interviews were found to be more reliable and valid than those prescriptions made from the analysis of error patterns.

(B. Sadowski)

Brownell, W.A. The evaluation of learning in arithmetic. Arithmetic in General Education. The Sixteenth Yearbook of the National Council of Teachers of Mathematics. Washington, D.C. 1941.

In this article, the author states his opinion against the trend to separate instruction and measurement. The effects of this attempted separation in his opinion are 1) to remove measurement further from the immediate learning situation, 2) to limit measurement to outcomes that can most readily be assessed, 3) to unduly limit the techniques which are serviceable for evaluation, and 4) to create confusion with respect to the purposes of evaluation. He lists four general classes of evaluation techniques and examples of each one: tests, teacher observations, individual interviews and conferences, and pupil reports, projects, etc. He places a good deal of responsibility on the classroom teacher when it comes to evaluation of students. He strongly favors questioning, interviewing and observing techniques for teachers to utilize in evaluation and measurement.

(J. Hornbaker)

Brueckner, L.J. Analysis of errors in fractions. Elementary School Journal, 1928, 28, 760-770.

A study of errors in fraction computation in which 83,800 examples were examined and 21,065 errors were classified. The causes in 20% of the examples were not possible to analyze, but the author concludes that the many peculiar types of errors listed clearly show the need to individualize instruction in order to pay attention to individual dfficulties.

(B. Sadowski)

Brueckner, L.J. Introduction. In Educational Diagnosis, the Thirty-fourth Yearbook of the National Society for the Study of Education, pp. 1-14. Bloomington, Ill.: Public School Publishing Company, 1935.

Educational diagnosis includes techniques for the evaluation of students' strengths, as well as weaknesses. For these purposes, there are many standard tests available, but by themselves they are not adequate diagnostic tools. Through other techniques such as observation, analysis or written work, analysis of oral responses, precise laboratory procedures, and interviews, numerous lists of the types of errors made by children have been compiled. This information provides further insight into learning difficulties, but we are still seriously handicapped by our lack of precise methods of testing and by our ignorance of the causes of most learning difficulties. We have been too concerned with the manifestations of difficulties through external symptoms. We must conduct research into their causes; to that end we need to make use of scientific technique.

(A. Graeber and K. Baxter)

Brueckner, L.J. Pedagogical factors associated with learning difficulty. In Educational Diagnosis, the Thirty-fourth Yearbook of the National Society for the Study of Education, Bloomington, Illinois: Public School Publishing Co., 1935, 49-62.

Inadequacies of the instructional situation that can contribute to learning difficulties are outlined as follows: (I) inadequacy and inefficiency of instructional materials, (II) faulty or unskillful instructional practices and procedures, (III) failure of instruction to provide for individual differences, (IV) ineffective guidance by teachers during learning activities, (V) undesirable personal and social relationships between teacher and pupils, and (VI) ignorance of the factors contributing to learning difficulties and failure to correct them. Much research data is used to support the author's assessments of each of these problem areas which is analyzed in terms of its effects on student performance.

(A. Graeber and K. Baxter)

Brueckner, L.J. Techniques of diagnosis. In Educational Diagnosis, the Thirty-fourth Yearbook of the National Society for the Study of Education. Bloomington, Ill.: Public School Publishing Co., 1935.

The author focuses much attention on the strengths and weaknesses of tests for diagnosing what he calls the essentials — reading, spelling, writing and numbers. In addition to the administration of diagnostic tests, other evaluative devices must be employed, including observation of students at work, systematic analysis of students' written and oral responses, and interviewing. Lists and analyses of the kinds of errors students make in algebra and arithmetic are available. In spite of some weaknesses, this research has thrown considerable light on the nature of learning. Many remedial measures have also been identified, but little

exact information concerning their effectiveness is available. More scientific technique needs to be employed in educational research.

(A. Graeber and K. Baxter)

Brueckner, L.J. The principles of devlopmental and remedial instruction. In Educational Diagnosis, the Thirty-fourth Yearbook of the National Society for the Study of Education, Bloomington, Ill.: Public School Publishing Co., 1935.

The consideration of numerous case studies gave rise to the author's formulation of fifteen principles that he considers basic to developmental and remedial instruction. Greatest emphasis is given to the first of these: the need to make growth of the individual the primary concern. Other principles include the observations that it is the child we are evaluating, not the subject matter; the total situation needs to be canvassed in order to determine the factors contributing to the learning difficulty, with special consideration given the emotional and social aspects; the remedial program should be viewed as an integral part of the normal classroom activities.

(A. Graeber and K. Baxter)

Brueckner, L.J. Diagnosis in arithmetic. In Educational Diagnosis, the Thirty-fourth Yearbook of the National Society for the Study of Education. Bloomington, Ill.: Public School Publishing Co., 1935.

The author discusses mathematics in a broad context, stating its four functions to be computational, informational, sociological and psychological; methods are proposed for diagnosing abilities as well as weaknesses in each of these areas. Factors contributing to growth in arithmetic ability and common symptoms of faulty learning are identified. It is stated that survey tests enable the teacher to determine the general phases of instruction that have been adequately stressed and those that need to be more fully developed. They must be followed by analytical tests for more precise diagnosis of difficulties. Any test results, however, have limited value. In order to obtain adequate data re: the pupils' methods of work or the nature of the errors made, four general methods are prescribed: (a) observation of pupils at work, (b) analysis of written work, (c) analysis of oral responses, and (d) interviews. Principles that should underlie the organization of the curriculum in arithmetic from the point of view of both developmental and remedial teaching are presented. The author concludes with specific techniques to improve instruction for all aspects of arithmetic, with emphasis on problem-solving.

(A. Graeber and K. Baxter)

Brueckner, L.J. Testing, diagnosis and follow-up in arithmetic. Elementary School Principal, 1959, 39(2), 33-36.

An article on the types of cases that can be identified by analyzing test results and the use of formal and informal procedures for evaluating student progress in arithmetic. A list of diagnostic procedures and principles of follow-up are also included.

(B. Sadowski)

Brueckner L.J. & Elwell, M. Reliability of diagnosis in the multiplication of fractions. Journal of Educational Research, 1933, 26, 175-185.

In this study 3438 specific errors were found over 6 types of fraction multiplication. The recommended procedure was to include at least 3 examples of each type in a test of individual diagnosis, since errors on single examples are likely to be due to chance. It was found that there was a relatively high degre of consistency in type of error or specific fault in a pupil's work when as many as 3 or 4 examples of a single type were solved incorrectly.

(B. Sadowski)

Brumbaugh, D.K. Reaction paper identifying and describing the remedial mathematics student. Remedial mathematics: Diagnostic and prescriptive approaches, papers from the First National Conference on Remedial Mathematics, ed. J.L. Higgins & J.W. Heddens. Columbus, Ohio: ERIC Center for Science, Mathematics, and Environmental Education, The Ohio State University, December, 1976.

Burns, E. & Granito, D. The effect of sex and test length of timed tests. Focus on Learning Problems in Mathematics, 1980, 2(2), 79-82.

In this study, the researchers administered a six minute timed test, covering 100 random multiplication facts to 200 children (50 each of second and third grade boys and girls). The results indicate that as time increases on timed tests, boys tend to decrease in accuracy more than girls.

(V. Amburgey)

Burton, G.M. For the sake of the chidren: Considerations for the math-anxious teacher. Focus on Learning Problems in Mathematics, 1979, 1, 61-67.

This article deals with the math anxious teacher in the elementary school and the effects that his (her) anxiety is likely to have on the pupils. Anxiety is described as a condition where the person knows that he is going to have to produce and will not be prepared to do so. The teacher suffering from this condition teaches out of duty and not out of enjoyment and this becomes obvious to the students.

The author makes several suggestions for overcoming math-anxiety starting with learning and/or re-learning the mathematics behind the math taught in the school. Asking for help and recognizing the problem will also benefit the math anxious teacher. Burton suggests that in trying to alleviate math anxiety one should start with reasonable goals and not unrealistic ones like "I will love teaching math". The person with a "math mind" is a person who has a high tolerance for frustration and determination not to give up.

(C. Bacon)

Buswell, G.T. & John, L. Diagnostic studies in arithmetic. Supplementary Educational Monographs, No. 30. Chicago: University of Chicago Press, 1925.

A summary of educational investigations relating to arithmetic. The move

from computational error analysis to an interview of the child where the thought process is emphasized is apparent in this report.

(B. Sadowski)

Buswell, G.T. & Judd, C.H. Individual differences and remedial methods. In Summary of educational investigations relating to arithmetic. Supplementary Educational Monograph No. 27., June 1925.

Studies of individual differences in mathematics from 1909-1924 are reviewed under five headings: (1) diagnostic and remedial methods, (2) analysis of various types of learners, (3) sex diffeences in arithmetic ability, (4) special disabilities in arithmetic and (5) descriptions of prodigies or extreme individual differences. An interesting review of early research in arithmetic diagnosis and remediation.

(B. Sadowski)

Caldwell, E. Group diagnosis and standardized achievement tests. The Arithmetic Teacher, February 1965, 13, 123-125.

The author describes a method that can be used to identify, from fall standardized test results, class difficulties with specific content in the basic skills. The steps are the following: (1) Determine essential skills taught during previous year

(2) Determine which questions measure skills in step 1

(3) Item analysis. (These first three comprise the class count on last year's skills.)

(4) List skills to be taught during this year

(5) Determine which test items cover these

(6) Item analysis. (These last three comprise the class count on this year's skills.)

The teacher would then compare and contrast the two resulting charts to determine the instructional emphases for the year. It would be possible to set up gross groupings for class instruction.

Calhoun, T.M. Diagnosis and remediation by elementary teachers using a manual for the remediation of a subtraction algorithm. Dissertation Abstracts, 1975, 37, 703A.

Investigated question of elimination of pupil weaknesses in using standard algorithms for fundamental operations. Explicit technique designed for diagnosing/remediating difficulties in standard subtraction algorithm. Objectives and activities designed. Significant gains shown in all groups of experiment. Different performance because of technique used not significant.

Callahan, Leroy G. Clinical evaluation and the classroom teacher. Paper presented at American Educational Research Association Meeting. New Orleans, February 25 - March 1, 1973.

This paper examines, and comments on, developmental activities in the evaluation of mathematics learning in the educational setting. General

specifications for evaluating cognitive process and product learning outcomes are presented. Clinical procedures in the formative evaluation of mathematics learning, incorporating video-tape technology, are suggested.

(L. Callahan)

Callahan, L.G. Neuroscience and remedial mathematics. From Proceedings of the third national conference on remedial mathematics, pp. 38-44. Kent, Ohio: Kent State University, 1976.

An overview of the theories of brain function is given in an attempt to relate the implications of contemporary developments of neuroscience to research in remedial mathematics. Evidence suggests that there is a neurological basis for lack of performance in mathematics for some students. The number is probably relatively small, yet the need for research is evident; little investigation has been made into the mathematical behavior syndromes of such children or the necessary instructional procedures. While our top priority in the study of mathematics instruction should be on the development of excellent classroom teachers and supervisors, the clinical center must continue to be an important component in the overall program.

(A. Graeber and K. Baxter)

Callahan, L.G. & Glennon, V.J. Elementary school mathematics: A guide to current research. Washington, D.C.: Association for Supervision and Curriculum Development (4th ed.), 1975.

This research monograph presents current research in elementary school mathematics in four general areas: curriculum, the child, the learning environment, and teaching method. Particular emphasis is placed on the essential aspects of the school mathematics program of the elementary school (K-4 or K-6) and the middle school (grades 5-7). A comprehensive bibliography containing empirical studies, model programs, theoretical concerns, and other pertinent research topics is included.

(K. Verbeke)

Campbell, P. & Kuln, G. Development and evaluation of consumer-based mathematics materials in adult basic education. Focus on Learning Problems in Mathematics, 1981, 3(1), 47-60.

This article is a report of a project which designed, implemented, and evaluated instructional materials for a consumer-based mathematics course in Adult Basic Education centers. The diagnostic test developed to accompany the experimental text was administered as a pretest and posttest to thirteen students at the Elston Adult School, Lafayette, Indiana. Analysis of paired test scores (Wilcoxon Signed Rank Test) revealed a statistically significant ($p < .001$) increase from pretest to posttest scores. Questionnaires measuring student, teacher, and administrator attitude indicated an overall favorable response.

(D. Simon)

Capobianco, R.J. Diagnostic method used with learning disability cases. Exceptional Children, 1964, 31, 187-193.

The article suggests that since research so far carried out had failed to classify brain injured subjects due to extreme variability in their observable behavior, diagnosticians should pay attention to symtomatology rather than etiology. It also lists a set of behavioral patterns which the author claimed to be possible indicators of learning disabilities and which responsible classroom teachers must keep complete records of.

(O. Inuenwö

Capps, L.R. Thoughts on coordinating a research effort in remediation in mathematics. From Proceedings of the third national conference on remedial mathematics, pp. 45-47. Kent, Ohio: Kent State University, 1976.

A survey of the literature makes it apparent that there are few studies on content objectives and the learning problems associated with them. For example, several studies were found dealing with the difficulty level of basic combinations, but little or no research on causes or successful remediation techniques. Research seems to be lacking on computation with any but whole numbers, and on remediation beyond the elementary school level. It is suggested that research efforts be coordinated, either through the formation of a group or through existing channels, such as the Arithmetic Teacher. The main purpose would be to review and summarize research studies, and to disseminate information. A skills inventory of individuals and institutions would help assess current efforts underway, and identify sources where needed research might be initiated.

Carlson, R.T. An investigation into the effects student tutoring has on self-concept and arithmetic computation achievement of tutors and tutees. Dissertation Abstracts International, 1973, 34, 2265A.

Designed to determine the effects of student tutoring on self-concept and arithmetic computation achievement. A second purpose was to determine effects of training on the computation and self concept of the tutors.

Involved were one hundred seventeen fourth and sixth grade subjects grouped as a) trained tutors, b) free-tutors, c) non-tutors, d) tutees of a, e) tutees of b, and f) non-tutees. The experiment lasted six weeks.

Conclusions were that self concept and arithmetic computation were not affected in any of the 32 comparisons using that test. Tutoring does not affect self-concept or computation scores of tutors or tutees.

Carroll, C. Low achievers' understanding of four logical inference forms: An analysis of difficulties and of the effect of instruction. Dissertation Abstracts International, 1971, 31, 4377A.

The research examined effectiveness of small group instruction on conditional reasoning tasks with low achieving ninth graders. Modus ponens, converse, inverse, and contrapositive reasoning was used in four different content dimensions. The effects of compulsive/reflective

cognitive style on the learning was examined. General improvement in performance was not significantly greater for the (E) groups over the (C) groups. (E) groups improved more on converse forms than (C) groups; no significant differences were evident for the other three forms. The (E) groups improved more on "misleading" and "removed from reality" content dimensions than (C) groups; no significant differences were evident for the other two content dimensions. Little relationship was found between cognitive style and reasoning skills.

(L. Callahan)

Cawley, J.F. & Fitzmaurice, A.M. Diagnostic procedure in mathematics. Focus on Learning Problems in Mathematics, 1979, 1, 17-23.

Diagnostic Procedures in Mathematics is an overview of the many different types of analyses and diagnoses, which are of importance in planning a corrective program. The article relates a need for a diagnostic procedure that would provide for a valid analysis between interaction and the content. The procedure should provide the following information: (1) content in which the learner is proficient; (2) the kinds of interaction which are most effective and efficient for the learner; and (3) the process with which the learner operates.

(P. Josey)

Ceci, S.J. & Peters, D.P. Memory, mathematics and cognitive functioning. Focus on Learning Problems in Mathematics, 1979, 1(2), 39-41.

This article dealt with a study carried out to ascertain if there is a relationship between the cognitive operations that form the basis of a child's ability to remember information and his/her skills on mathematical computations that deal with subtraction requiring regrouping. There was a significant difference in the groups on problems requiring regrouping. The mean time for the flexible group was 3.29 seconds, while that of the inflexible group was 6.05 seconds. Yet, no significant difference was found on problems requiring no regrouping.

(D. Houston)

Cheek, J.F. A study of retention of arithmetic learning with children of low, average and high intelligence at 127 months of age. Dissertation Abstracts, 1959, 20, 955-956.

Twenty boys and twenty girls of low intelligence (IQ of 55-80), twenty boys and twenty girls of average intelligence (IQ of 90-110), and twenty boys and twenty girls of high intelligence (IQ of 120+) were presented with two types of arithmetic learning tasks (subtraction and problem solving). The tasks were carefully determined for appropriateness of difficulty level. The hypothesis that retention is the same among children of low, average, and high intelligence when tasks are adjusted to achievement level was tested. For both the subtraction tasks and problem solving tasks, no significant differences in retention ability was found.

(L. Callahan)

Chicorel, M. Chicorel abstracts to reading and learning disabilities: 1977 Edition. Vol. 19. (Index Series) 1977. New York: Chicorel Library.
Serves as index to materials on learning disorders. 500 publications with thorough, descriptive abstracts are listed under subject areas. Most useful will be diagnostic and remedial chapters that do contain math related publications.

Cleaver, G. Rx for the secondary math dropout: the math learning clinic. Focus on Learning Problems in Mathematics, 1980, 2(1), 73-76.
The author briefly describes a program which involved secondary students and some adults who were no longer in school, attending a summer secondary math clinic.

(V. Amburgey)

Cochran, C.E. An experimental study of achievement of intermediate educable mentally retarded students. Dissertation Abstracts International, 1971, 31, 4031A.
The effect of a curriculum variation on the academic achievement of intermediate EMR students was examined. A treatment program in verbalized concept development was taught instead of arithmetic computation instruction. One group received the treatment program while the other group was taught the usual curriculum. After six weeks the order was reversed. The data analysis suggested that there were few measurable differences on the arithmetic measures used in the study as a result of the treatment.

(L. Callahan)

Cohen, M.S. A comparison of effects of laboratory and conventional mathematics teaching upon underachieving middle school boys. Dissertation Abstracts International, 1971, 31, 5026A-5027A.
Two groups of sixth-grade students equated on arithmetic computation scores and IQ scores were taught addition and subtraction of integers. One group used concrete, or visual, procedures in instruction; the other used abstract, or algebraic, procedures. The research attempted to determine which group understood addition and subtraction of integers better as a result of the different instructional treatments. No statistically significant difference was found in the achievement of the two groups.

(L. Callahan)

Connolly, A.J. An instrument of measurement to appraise the arithmetic abilities of educable mentally retarded children ages thirteen through sixteen. Dissertation Abstracts, 1968, 29, 1034A.
The study involved the development of an arithmetic test to assess arithmetic ability of EMR youngsters, 13-16 years of age. Initially validated items were incorporated into a preliminary instrument and administered to 45 retarded youngsters in a pilot study. Analysis of the pilot test was carried out and the instrument for the main study finalized.

The test instrument was administered to 400 EMR's enrolled in special classes. An item analysis of the results were used to eliminate some items and to order remaining items. Reliability was analyzed with test-retest and split-half methods, and further validity checks were carried out. It was concluded that the instrument developed provided a practical and valid measurement of arithmetic abilities of EMR youngsters whose ages fall within the range of the test.

(L. Callahan)

Cook, W.W. Functions of measurement in the diagnosis and treatment of learning difficulties. In Educational measurement, (E.F. Lindquist, Ed.) Washington, D.C.: American Council on Education, 1966.

Schools organize learning experiences sequentially; therefore in order to diagnose difficulties, it is necessary to measure a student's level of accomplishment within a given sequence. A general achievement test is designed to express this measurement in terms of a single score. It is too general to guide instruction for individual pupils. Diagnostic testing, on the other hand, is designed to reveal specific deficiencies. It generally takes two approaches: readiness testing which frequently emphasizes discovering which pupils should be placed in a given sequence, and diagnostic testing which is administered after a period of instruction. Many elementary school teachers carry on almost constant diagnosis through their teaching methods. Expertly prepared tests can make that task more thorough and efficient.

(A. Graeber and K. Baxter)

Copeland, R.W. How children learn mathematics: Teaching implications o. Piaget's research. New York: MacMillan Publishing Company, 1974.

The beginning chapters of this book weave together a perspective from which the reader can then consider children's learning of mathematics. Piaget's research and theory of intellectual development form the foundational work on which the perspective of the book is developed. Suggested methods of presenting mathematics experiences are based upon the Piagetian view of how children learn. The teaching of arithmetic and geometric topics are examined from the Piagetian perspective. The Mathematics Laboratory approach to instruction is considered in one of the final chapters.

(L. Callahan)

Copeland, R.W. Math activities for children: A diagnostic and developmental approach. Columbus, Ohio: Charles E. Merrill Co., 1979.

A book of 62 activities which determine the quality or stage of a child's thinking. The child's performance on the activities can serve as a basis for planning instruction in elementary mathematics. The activities are sequenced for the child's intellectual development within seven basic areas (1) logical classification, (2) number, (3) space orientation, (4) measurement, (5) knowing versus performing, (6) mathematical memory, and (7) chance and probability.

(B. Sadowski)

Crenson, J. Learning disabilities in mathematics. From Proceedings of the third national conference on remedial mathematics. Kent, Ohio: Kent State University, 1976.

Only in recent years have mathematics educators given widespread attention to diagnosis and remediation; for the most part, research in these areas has been perfunctory, dissemination almost non-existent. Others in the field of education have placed emphasis on the loose term, "learning disabilities," with resultant classroom procedures that are based on questionable research as well as lacking specific application to math difficulties. Models must be created that provide strategies and techniques for diagnostic/prescriptive teaching of mathematics. This calls for a united front of mathematics educators to bring about extensive and responsible research, along with the requisite dissemination that will enable the findings to have an impact on classroom teaching.

(A. Graeber and K. Baxter)

Demars, R.J. A comparative study of seventh grade low achievers' attitudes and achievement in mathematics under two approaches, UISCM and traditional. Dissertation Abstracts International, 1972, 32, 4832A.

The purpose of the study was to measure low achievers' achievement and attitude in seventh grade mathematics when using the UISCM program Stretchers and Shrinkers as compared to using the traditional text. The results showed no significant differences between the groups in atttitude or achievement, but the mean gains favored the group using the UISCM programs. The teaches preferred the UISCM program because of the opportunity the program provides for success and the manner it presents the basic concepts promotes better understanding.

(F. Kelly)

Denmark, T. Diagnosis of entry concepts and skills: Grades one and two. From Proceedings of the third national conference on remedial mathematics, Kent, Ohio: Kent State University, 1976.

Prevention is viewed as the primary purpose of diagnostic teaching, particularly in the early grades. The development of a successful diagnostic program depends upon the ability to understand children's thought processes in all of their work with mathematics. Examples of first and second graders' responses to diagnostic questions are taken from 1974 and 1975 assessments made by Project for the Mathematical Development of Children. Skills that were tested include knowledge of one-to-one correspondence, counting, and conception of equivalent sets; the latter indicated that most children had a clear conception of equivalent sets, but their definition is not the one which is supposedly taught in the school curriculum. It is emphasized that testing must make use of a variety of tasks, in order to compensate for difficulties that may arise from non-mathematical conditions such as unfamiliar vocabulary or manner of giving directions.

(K. Baxter and A. Graeber)

Dodd, C.A., Jones, G.A., and Lamb, C.E. Diagnosis and remediation of pupil errors: An exploratory study. School Science and Mathematics, March, 1975, 75, 270-276.

Dodd, Jones, and Lamb studied the effects of training on the ability of preservice teachers to identify children's error patterns in multiplication and to prescribe appropriate remedial activities in multiplication. Preservice teachers at Indiana University self-selected either a regular mathematics methods course, preceded by nine units of mathematics content courses, or an experimental combined mathematics content and methods course. Subjects in both groups studied the teaching of numeration, addition, and subtraction. The experimental group also received instruction in identifying addition and subtraction error patterns and in prescribing appropriate instruction to correct the errors. Subjects were tested with open-ended written instruments to measure their diagnostic and presciptive abilities for multiplication. An analysis of covariance showed there was no significant treatment effect for diagnostic ability, but there was a significant difference in favor of the experimental group on prescriptive ability.

(S.L. Young)

Doggett, M. Aiding the seriously deficient learner. The Mathematics Teacher, 1978, 71(6), 488-493.

Premotivation as the key to success is a prime premise of this article. Learners are motivated when they feel desire, want, yearning, wish or lack. Without one or more of these emotions learners make little or no progress. The author feels that the mathematics lab is the solution to motivation. The lab teachers are encouraged to show enthusiasm; parents are urged to call regularly; students are requested to help one another. Premotivational activities are used before the students are admitted to the lab. Students set their own goals in terms of skills learned and time required.

(A. Leef)

Driscoll, M.J. Research within reach: elementary school mathematics. Focus on Learning Problems in Mathematics, 1980, 2.

This series attempts to increase communication among researchers and practitioners of elementary school mathematics. Questions that have arisen from classroom situations are translated into research questions and appear as "research bulletins" in several issues of this journal.

(V. Amburgey)

Driscoll, M.J Research within reach: elementary school mathematics. Algorithms in elementary school mathematics. Focus on Learning Problems in Mathematics, 1980, 2(4), 55-66.

The author, in this article, takes a look at the literature regarding the teaching of algorithms in elementary school mathematics. His focus is on

the topics concerned with choosing, developing, teaching, and practicing algorithms.

(V. Amburgey)

Driscoll, M.J. Research within reach: elementary school mathematics. Estimation and mental arithmetic. Focus on Learning Problems in Mathematics, 1980, 2(2), 71-77.

The author points out that elementary teachers often overlook the importance of estimation and mental arithmetic. These concepts can and should be taught to all students, beginning early and continuing regularly throughout the elementary school years.

(V. Amburgey)

Driscoll, M.J. Research within reach: elementary school mathematics. Evaluation in mathematics education. Focus on Learning Problems in Mathematics, 1980, 2(2), 57-69.

The author has addressed the topic of evaluation in two articles. In part one, he discusses various means of evaluating students. Paper and pencil tests are only one form of evaluation, but are used all too often as the only means. The author points out that teachers should be aware of and use other means. In part two, the author extends this topic by taking a closer look at assumptions, strategies, and research in mastery learning.

(V. Amburgey)

Driscoll, M.J. Research within reach: elementary school mathematics. Meaning and retention in elementary school mathematics. Focus on Learning Problems in Mathematics, 1980, 2(1), 25-30.

Children who learn the internal structures and meaning of mathematics as well as its applications to social situations seem to retain their basic facts and computational skills better than students who were exposed primarily to rote memorization and drill and practice.

(V. Amburgey

Driscoll, M.J. Research within reach: elementary school mathematics. The role of manipulatives in elementary school mathematics. Focus on Learning Problems in Mathematics, 1980, 2(4), 67-78.

The author describes what the role of the primary teacher should be in regard to a child's experiences with manipulatives. He discusses various kinds of manipulatives and suggests some uses of those manipulatives in the elementary mathematics classroom.

(V. Amburgey)

Driscoll, M.J. Research within reach: elementary school mathematics. Sequence with substance: the elementary school mathematics curriculum. Focus on Learning Problems in Mathematics, 1980, 2(2), 47-56.

This article focuses on research related to the sequence of elementary school mathematics curricula. It attempts to answer questions regarding

such topics as the introduction of subtraction to the first grade students so early in the school year.

(V. Amburgey)

Dunlap, W.P. A comparison of the effects of diagnostic and remedial arithmetic programs upon the achievement and attitude development of fourth grade children. Dissertation Abstracts, 1971, 31A, 2905-2906.

This study compared the effects of two experimental arithmetic treatments upon the achievement and attitudes of fourth grade children. The first treatment utilized exclusive use of paper and pencil activities from an arithmetic textbook. The record treatment relied heavily on the use of games, puzzles and manipulation of physical objects by the subjects. At the end of the study, all children are administered scales, Comprehension Test of Brain Skills: Arithmetic and an experimenter-designed achievement test. Three means of children's arithmetic achievement were obtained: 1) comprehension skills, 2) knowledge of concepts, and 3) application of process. No significant difference between treatments were found for the 3 areas of arithmetic achievement or for attitudes. However, on experimenter designed achievement test, the record treatment was found on the concepts section while the first treatment was found on the comprehension section.

(M. Gage)

Dunlap, W.P. & Kalmey, A. Diagnosing children's mathematics difficulties in kindergarten. Focus on Learning Problems in Mathematics, 1980, 2(4), 9-26.

Since kindergarten children are primarily exposed to a visual mode of instruction, it becomes obvious that children who have poor visual skills would have difficulty in the classroom. Therefore, it becomes helpful for teachers to have a diagnostic procedure to use with these students in order to adequately plan for instruction. The authors identified seven specific visual skills that kindergarten children must have in order to function in the mathematics classroom. Then, they developed and tested a diagnostic procedure with an adapted tachistoscope for each skill area. This article discusses the procedure and two case studies.

(V. Amburgey)

Durall, E. A feasibility study: Remediation by computer within a computer-managed instruction course in junior high school mathematics. Dissertation Abstracts International, 1972, 33, 2611-2612A.

This study investigated the feasibility of presenting remedial instruction to students by computer as compared to remedial instruction by a teacher. Seventh grade students who had achieved less than 80% on a test were given remediation by a teacher. The other half received remediation from an instructional sequence programmed into a computer. The results of the study demonstrated favorable results for the computer-remediated students of high ability while the lower ability students favored the

teacher-remediated setting. The computer-remediation was not detrimental but the teacher remediation was apparently more supportive. Highly positive attitudes toward mathematics in general were exhibited by both groups of students at the end of the study.

(M. Gage)

Dutton, W.H. Evaluating pupils' understanding of arithmetic. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964.

Although the teaching of mathematics has undergone a great deal of change, there seem to be few tools for evaluating the effectiveness of math curricula. The author emphasizes the need for evaluation and provides evaluation instruments for both old and new math programs. Included is a review of the reasons for the development of new math programs and a review of research on evalution procedures in mathematics. There are suggestions for the construction and use of tests to measure pupil understanding of selected arithmetical concepts in grades 3 through 6, and suggestions for informal evaluation which should be used in the day-by-day teaching of arithmetic.

(A. Graeber and K. Baxter)

Ebel, R.L. Using tests to improve learning. Arithmetic Teacher, 1979, 27(3), 10-12.

The article stresses 'public' assessments of student learning; also responds to opponents of standardized test and testing, and further discusses control of curricula, teaching to the test, and test bias.

(C. Kochheiser)

Eichler, F. Rationale for remediating the math difficulties of learning disabled students. Focus on Learning Problems in Mathematics, 1980, 2(4), 37-47.

The author identifies four main areas of dysfunction as the causes of math errors of learning disabled children. Each area is discussed briefly and followed by theories of remediation and activities for remediation for that area.

(V. Amburgey)

Ellis, L.C. A diagnostic study of whole number computations of certain elementary students. Dissertation Abstracts International, 1972, 33, 2234.

The purposes of the study were to determine the types and frequency of errors committed by selected elementary (6th grade) students in computations with whole numbers, and to analyze the specific types of exercises for difficulty. The numerous types of errors seemed to suggest a need for individualized, diagnostically oriented instruction in all operations.

(R. Connelly)

Engelhardt, J.M. Diagnosis and remediation in school mathematics: Developing continuity among R and D efforts. From Proceedings of the

third national conference on remedial mathematics. Kent, Ohio: Kent State University, 1976.

Further investigation of mathematics diagnosis is needed regarding: (1) individual difference variables which potentially affect student performance in diagnostic situations; (2) internal structure of diagnostic testing – type of items, response format, etc.; (3) the role of language in diagnosis; (4) teacher behavior in the diagnostic situation; and (5) examination of student errors as a diagnostic technique. Further investigation is also needed re: the effectiveness of existing remedial programs and techniques for educating mathematics teachers. To improve continuity among all of these efforts, the following steps are suggested: the establishment of a diagnostic/remedial newsletter, the development of common literature surveys, and the establishment of common data collection across mathematics clinics.

(A. Graeber and K. Baxter)

Engelhardt, J.M. Remediation of learning difficulties in school mathematics: Promising procedures and directions. Paper presented at the National Conference on Remedial Mathematics. Kent, Ohio, May 1974.

The purpose of the paper was to identify possible remedial instructional procedures in school mathematics, and suggest directions for future study. It included a review of research in the areas of readiness, instruction, and individual differences in mathematics learning, and an examination of three identified needs in remediation.

(R. Connelly)

Englehardt, J.M. & Wiebe, J.H. An investigation of the underlying assumption of error analysis in arithmetic, Focus on Learning Problems in Mathematics, 1981, 3(1), 13-24.

This article is a report of a research study which attempted to determine what relationship, if any, exists between computational errors usually associated with whole-number numeration misunderstandings and such misunderstandings. Errors made by 172 fourth grade students on the Key Math Diagnostic Arithmetic Test were classified as numeration errors according to an established criteria. Numeration misunderstandings were measured by errors on the Inventory of Numeration Concepts. Findings of the study lend credence to the contention that computational errors indicate conceptual misunderstandings.

(D. Simon)

Engelhardt, J.M. & Wiebe, J.H. Measuring diagnostic-remedial competence in teaching elementary school mathematics. Tempe, Arizona: Arizona State University, 1978. (ERIC Document Reproduction Service No. ED 177 018)

The authors developed an instrument to measure teacher's competencies in mathematics diagnostic-remedial teaching situations. The instrument contains open-ended items about hypothetical diagnostic-remedial

situations. It measures one competency for diagnosis and four competencies for remediation. The instrument was administered to inservice teachers enrolled at Arizona State University in a diagnostic-remedial course that included experience in a mathematics clinic. The researchers reported an average score increase of 59 percent during the semester.

(S.L. Young)

Fennell, F.M. The effect of diagnostic mathematics instruction on the achievement and attitude of low-achieving sixth-grade pupils. Dissertation Abstracts International, 1973, 33, 3378A.

Fennell trained some preservice teachers in diagnostic instruction techniques and others in the use of a textbook. The preservice teachers trained in diagnostic teaching taught small groups of sixth graders, the experimental group, utilizing the techniques they learned. Those trained in the textbook method taught small groups of sixth graders in the control group using that method. Significant pupil gains were reported for both methods, but there was no treatment effect for mathematics content knowledge. There was also no treatment effect for attitude.

(S.L. Young)

Fernald, G.M. Remedial techniques in basic school subjects. New York: McGraw-Hill Book Company, 1943.

Dr. Fernald basically reports certain psychological experiments regarding the development of skills in basic school subjects. Case studies are reported that verify the effectiveness of her kinesthetic technique in teaching non-readers to read. In addition Dr. Fernald includes in her book an account of her methods of treating arithmetic disabilities. Her personal philosophy was "that there is no such thing as a person of normal intelligence who cannot learn the basic skills of reading, writing, and arithmetic."

(M. Moye)

First National Conference on Remedial Mathematics. Papers from the Conference on Remedial Mathematics: Diagnostic and Prescriptive Approaches. 1976. (ERIC Document Reproduction Service No. ED 147 184)

Speeches and reactions from the 1974 National Conference on how to identify and describe remedial math students, classroom diagnosis, clinical diagnosis, the diagnostic process, and promising procedures in remediation. 141 pages.

Fleischner, J.E. & Frank, B. Visual-spatial ability and mathematics achievement in learning disabled and normal boys. Focus on Learning Problems in Mathematics, 1979, 1, 7-22.

This article reports the findings of a study based on the assumption that math achievement is related to visual perceptual ability. The study was undertaken to determine whether the mathematically disabled student has

limited ability to make, retrieve, and manipulate visual images and will, as a consequence, score poorly on tests tapping these abilities. Ninety-seven fourth, fifth, and sixth grade boys and fourty-seven learning disabled boys were given a battery of tests to determine their mathematical achievement. Based on test results it was concluded that the arithmetic learning problems of elementary school aged children may frequently be related to immaturity or dysfunction of visual perception and because of this probable relationship continued investigation in this area seems warranted.

(A. Ramirez)

Flinter, P.F. Educational implications of dyscalculia. Arithmetic Teacher, 1979, 26(7), 42-46.

An article that discusses the symptomatology and remediation of the dyscalculic child in areas of verbal disturbances; disturbances of visual-spatial organization, reading and writing numbers; impairment in understanding concepts while performing mental calculations; disturbances in operations; and confusion of place value and direction in computation.

(B. Sadowski)

Fowler, M.A. Diagnostic teaching for elementary school mathematics. Arithmetic Teacher, 1980, 27(4), 34-37.

Fowler poses three important questions which must be considered in using diagnostic teaching. (1) Exactly what errors are made? (2) What is the rationale for the errors? (3) What needs to be learned in order to remediate the situation? Then by discussion with examples she suggests some answers to the questions. Her belief is that diagnostic teaching is one approach to individualization that can be used in any class structure or curriculum organization.

(K. Hodgin)

Fullwood, H.L. A follow-up study of children selected by the Frostig developmental test of visual perception in relation to their success or failure in reading and arithmetic at the end of second grade. Dissertation Abstracts, 1969, 29, 2035A.

Using achievement levels in reading and arithmetic obtained from each child's teacher, pupils selected as having high visual-perceptual ability (high P.Q.) performed significantly better than those having low P.Q..

(R. Connelly)

Gardner, T.P. The efficacy of teacher utilization of an experimental diagnostic arithmetic survey with selected educable mentally retarded students. Dissertation Abstracts International, 1972, 32, 5068A.

The investigator concluded that the experimental edition of the Gardner-Camtrell Diagnostic Survey of Academic Fundamentals, Arithmetic Level

II had no demonstrated effects related to arithmetic achievement gains of EMR students (intermediate and junior high level.)

(R. Connelly)

Glennon, V.J. Some perspectives in education. Enrichment mathematics for the grades. Twenty-seventh Yearbook. National Council of Teachers of Mathematics, Washington, D.C. 1963.

The purpose of this article is to discuss how to provide learning experiences in mathematics for the talented children in the elementary schools. The topics discussed are: a balanced program, mathematics provided for the talented, identification of the mathematically talented, grouping of talented children, teaching methods that should be used. The contention of the author is to extend and enrich the program through topics related to and continous with the basic school mathematics program.

(S. Fulk)

Glennon, V.J. ...And now synthesis: A theoretical model for mathematics education. Arithmetic Teacher, 1965, 12(2).

In this article synthesis is described as the integration of the thesis of content with the antithesis of method. The author discusses his theory of mathematical education made up of cultural, psychological, and cognitive foundations. Answers the questions of what mathematics should be taught and how mathematics should be taught.

(S. Fulk)

Glennon, V.J. Method-a function of a modern program as complement to the content. Arithmetic Teacher, 1965, 12(3), 181-182.

The author describes mathematics education as the intersection set of the psychological, cultural, and mathematical foundations. This article discusses the historical background of psychological thought and theory in relation to the stimulation of the study of method.

(S. Fulk)

Glennon, V.J. & Wilson, J.W. Diagnostic-prescriptive teaching. In The Slow Learner in Mathematics, the Thirty-fifth Yearbook of the National Council of Teachers of Mathematics (W.C. Lowry, et al., Eds.) Washington, D.C.: National Council of Teachers of Mathematics, 1972.

In this discussion of diagnostic-prescriptive teaching of mathematics for slow learners, the problem is approached in a broad context, considered to be "as large as a theory of instruction itself," and takes into account the numerous causes of learning difficulties in addition to those that are cognitive. A taxonomy for the content of elementary school mathematics is presented, with the work of learning theorists Gagne and Bloom discussed. Group techniques for diagnostic-prescriptive teaching have emphasized product, while individual methods emphasize process; both approaches are necessary, but we have overemphasized the former. Lessons are presented from a case study in which the content taxonomy was used by the teacher

as a guide in the selection of objectives and of relevant group and individualized teaching procedures.

(K. Baxter and A. Graeber)

Gray, R.F. An approach to evaluating arithmetic understandings. The Arithmetic Teacher, 1966, 13(3), 187-191.

This article stresses the need for a measurement instrument to evaluate pupil progress towards achieving mathematical understanding. The author advocated the use of an individual-interview procedure which he developed using multiplication problems. His procedure was aimed at overcoming the weaknesses of these types of interviews: reliability, economy of administration and statistical analysis. Scoring techniques were structured so the interviewer only needed to go through a series of systematic steps each of which involved choosing one of two alternatives. Five interviewers were selected and carefully trained on practice interviews to third graders. The results of the interviews indicated success at overcoming the limitations of these interviews, and the scoring procedure greatly improved the consistency of scoring the interviews.

(J. Hornbaker)

Greenes, C.E. The learning disabled child in mathematics. Focus on Learning Problems in Mathematics, 1979, 1, 5-11.

The strong feature of this article is the assertation that children with specific learning disabilities in mathematics may be victims of dyscalculia (a disorder in the ability to do or to learn mathematics).

Dyscalculic children often display visual perceptual impairments. Poor visual perception skills generally lead to poorly developed concepts of space, and results in difficulties in mathematics in the areas of : (1) sequencing, (2) directionality, (3) measurement, (4) geometric forms, and (5) conservation of quantity. To help the dyscalculic child emphasis must be placed on the development of concepts of space.

(L. Moseley)

Gregory, J.W. Test failure and mathematics failure—there is a difference. Arithmetic Teacher, 1979, 27(3), 50-52.

An informal report of a research study on test taking ability versus mathematical ability of sixth-, seventh-, eighth-graders, high school general mathematics and first-year algebra students. The results show a surprisingly large number of clerical errors and caution the use of scores obtained from standardized tests.

(C. Kochheiser)

Guerriero, C.A. Predictors of eighth grade mathematics achievement. Focus on Learning Problems in Mathematics, 1979, 1, 69-73.

This article discusses variables that predict achievement in mathematics. Pennsylvania's state assessment program - Educational Quality

Assessment - makes an attempt to measure mathematics achievement and collects data on a wide variety of variables that can be used to predict that achievement. Some of the variables used in the prediction are building variables, teacher variables and student variables. Within the limitations of the data collected by EQA, it appears that non-manipulative variables including, sex, family size, race, and socio-economic status of the family are not as powerful in predicting mathematics achievement as are certain manipulative variables. Expectations of student performance and educational objectives, on the part of parents, teachers and students themselves, tend to be the best predictors.

(B. Bradford)

Guiler, W.S. Difficulties in decimals encountered by ninth-grade pupils. Elementary School Journal, 1946, 46, 384-393.

The Christofferson-Rush-Guiler Analytical Survey Test in Computational Arithmetic was administered to 936 ninth grade students in five Ohio school systems in the mid-1940s. The students' weaknesses that appeared in the decimal portion of the test were discussed in the article. The errors ranged from fraction-decimal conversions to those of computational and decimal point placement mistakes. Since the decimal gaps were so severe with numerous students, it was suggested that poor administrative and teaching techniques were possibly at fault and that the schools must accept the responsibility of providing remedial programs to those students who needed additional decimal instruction.

(M. McIntyre)

Gunderson, A.G. Thought-patterns of young children in learning multiplication and division. Elementary School Journal, 1955, 55, 453-61.

Twenty-four second graders from the University of Wyoming Elementary School were selected to help determine the thought processes used in solving multiplication and division problems. These students had no previous multiplication and division instruction and experiences. They had had extensive concrete, semiconcrete, and abstract activities in solving addition and subtraction problems though. The students were individually interviewed as they solved 5 multiplication and 4 division word problems. It was discovered that the students relied on their previous experiences, as well as the available materials to solve the unfamiliar situations. Second grade was also acknowledged as a suitable grade to introduce multiplication and division problems.

(M. McIntyre)

Heddens, J.W., Underhill, R.G. & Uprichard, A.E. Diagnosing mathematical difficulties. Columbus, Ohio: Charles E. Merrill, 1980.

Based on psychological and conceptual perspectives, the authors discuss many areas concerning diagnosis of mathematical difficulties. The authors include descriptions of three models for diagnosis and the implementation of these models in classroom or clinical settings. Also included are

descriptions of commercially produced diagnostic tests, such as Keymath, Stanford, and others. Teacher-made tests and questioning techniques are given as examples of data-gathering strategies. Graduate students and researchers may be interested in the research methods and issues of concern that are elaborated upon.

(V. Amburgey)

Heimer, R.T. & Trueblood, C. Strategies for Teaching Children Mathematics. Reading, Mass.: Addison-Wesley Pub. Co., 1977.

Beginning chapters address cognitive objectives, learning hierarchies in math, assessment of readiness, teaching principles, diagnostic/prescriptive strategies (one page), retention tactics. Bibliographies included with each chapter. Chapters contain theory section and practice experience. Presentation of practical applications of the four fundamental operations on whole and rational numbers is useful.

Homan, D. The child with a learning disability in arithmetic. Arithmetic Teacher, 1970, 18, 199-203.

The author states that learning disability in arithmetic stems from cerebral dysfunction or emotional disturbance - not from mental retardation, sensory deprivation, cultural or instructional factors. But no matter what the cause, diagnosis must lead to remedial recommendations. Diagnosis is better named assessment. She lists some of the difficulties often associated with learning disability in arithmetic: difficulty with spatial and size relationships; motor disinhibition; left-right confusion; perseveration; difficulty with language symbols; difficulty with reasoning. Specific suggestions for instruction based on the above difficulties are given.

Hopkins, M.H. The diagnosis of learning styles in arithmetic. Arithmetic Teacher, 1978, 25(7), 47-50.

The article discusses diagnosis as it applies to individualized instruction in arithmetic at the elementary level. The author points out strengths and weaknesses of various kinds of tests and mentions other factors essential to a complete diagnosis: (1) the child's physical, emotional and environmental conditions, (2) the level of understanding displayed by the child in the area tested (concrete, representational, symbolic), and (3) the most effective learning style of the child. Two formats for developing tests to diagnose learning style are suggested. (1) Give the child a task and a choice of materials keyed to various sensory modalities and infer the preferred learning style from the materials chosen for use. (2) Provide the child with learning experiences that employ various sensory modalities and infer the preferred learning style from the level of success attained with each.

(K. Hodgin)

Hopkins, M.H. Teaching arithmetic: A diagnostic approach. Bradenton, Florida: Hopkins, 1977.

This concise book deals with the instruction of addition and subtraction of whole numbers. Sequences for instruction diagnostic tests, analysis sheets for tests and errors patterns are included.

(M. Hynes)

Hynes, M.C. Response modes and diagnostic procedures: Needed research. From Proceedings of the third national conference on remedial mathematics, Kent, Ohio: Kent State University, 1976.

Researchers agree that children move sequentially from concrete response modes in mathematical performance to symbolic modes, with intervening stages. Techniques for diagnosing the various response modes do exist, but we have little knowledge for determining effective sequence for testing. A product-oriented philosophy uses other response modes only for those skills judged to be unsatisfactory by initial testing done at the abstract level. A process-oriented philosophy uses all response modes for testing, regardless of student strengths or weaknesses, but might use either sequence—abstract to concrete, or the reverse. Four levels of diagnosis used at the Arithmetic Center at the University of Maryland suggest an overall abstract to concrete testing sequence, but it is not always clear whether specific diagnostic activities should begin on the abstract or the concrete level. Research is needed if we are to understand the most appropriate sequence for producing information which allows the effective prescription of remedial instruction.

(K. Baxter & A. Graeber)

Ingram, C.P. Education of the slow learning child. New York: Ronald Press Co., 1960.

This book examines the needs and potentialities of the mentally retard and slow learning child and presents educational programs designed to discover and develop the assets of a wide range of such children. The book first outlines the physical, mental, social, and emotional characteristics of educable retarded or slow learning children; then the psychological and educational principles underlying the objectives for a program geared to their potentialities are set forth. Special emphasis is placed on what retarded children can reasonably be expected to achieve functionally at different periods in their school experience in language arts, arithmetic, social studies, science, and other subject areas.

(F. Fennell)

Irons, J.L. The mathematics clinic. In Resources in Education. Educational Resource Information Center. ED 103 262, Vol. 10, No. 7, July 1975.

This paper presents the design for the mathematics clinic at Stephen F. Austin State University. In developing this design, several outstanding clinics were visited and brief descriptions of their programs are reported. These include clinics at Arizona State University, Florida Technological

University, Kent State University, The University of Maryland and the University of South Florida.

(J. Irons)

Irons, J.L. The need for packaged material and a delivery system. In Heddens, James W. (Ed.), Proceedings of the third national conference on remedial mathematics. Kent, Ohio: Kent State University, 1976.

There is a current need for informal diagnostic materials among practicing teachers. Those professionals who instruct in special education, Title I Math and math resource rooms are faced with this need each day without the benefit of these materials. Of equal importance to the materials problem is that of disbursement and training. A system for informing teachers of available materials and how to use these must be developed.

(J. Irons)

Johnson, M.L. The role of Piagetian theory and "Piagetian-type" tasks in mathematics diagnosis and remediation. From Proceedings of the third national conference on remedial mathematics. Kent, Ohio: Kent State University, 1976.

The usefulness of Piagetian theory to diagnostic and remedial instruction of mathematics is examined, particularly at the concrete operational level of children's cognitive development. Three examples are provided of the tasks that Piaget developed to help evaluate children's degree of understanding for certain arithmetical and geometrical ideas. It is concluded that knowledge of Piagetian theory would be helpful to a clinician in designing instructional activities; knowing, for example, that concrete operational children reason on objects and events that are real to them, should assist in choosing appropriate learning experiences. More research is needed, but Piagetian theory has already demonstrated usefulness, one of its major implications to current mathematics instruction being the concept of gathering information from interviews.

(K. Baxter and A. Graeber)

Johnson, S.W. Arithmetic and learning disabilities. Boston: Allyn and Bacon., 1979.

A book designed to help elementary school teachers pinpoint and attack specific problem areas where learning disabilities interfere with children's arithmetic performance. This two part book introduces learning disabilities and discusses these disabilities in relation to teaching elementary arithmetic. Practical, illustrated examples of learning problems in specific curriculum areas are also presented. Features of the book include (1) step-by-step procedures for identification and remediation of problems, (2) a coding system and locators which help teachers find activities easily, (3) interactions of specific learning disabilities with the pre-school and elementary arithmetic curricula are explored, and (4) examples of problem-free behavior, areas where problems are observed,

simple diagnostic activities, remedial objectives and examples of remedial activities.

(W. Speer)

Johnson, S.W. Identifying and remediating the effects of learning disabilities in arithmetic. Focus on Learning Problems in Mathematics, 1979, 1, 7-15.
A critical report on the need for better training of remediators, practitioners, math teachers, math specialists or instructional managers in analyzing the learning behavior of students in the area of arithmetic. Three major components are delineated as a prescription diagnosis strategy for remediation of learning disabilities in arithmetic, along with an outline of three vital components as a need for the professionals in training to be sensitive to and well-trained. The curriculum of a kindergarten child in the major content area of arithmetic is used as an example to point out the kinds of behavior involved and the interaction of the verbal learning difficulty with the demands of the arithmetic curriculum.

(G. Washington)

Jones, J.V. A predictive assessment of overt classroom behavior and the academic achievement of mentally retarded students. Dissertation Abstracts, 1972, 32, 5070-5071A.
Sixty-five educable mentally retarded students enrolled in five special education classes, grades 7-12, were used in this study. Results showed that observable behavior (recorded by a trained observer) contributed a total of 29 percent to the predictability of the dependent variable, arithmetic. When demographic data were included with behavioral data in the regression formula, IQ accounted for more variance (30 percent) than all of the observational data together.

(D. Edge)

Jones, R.C. A diagnostic-manipulative instructional program for teaching addition and subtraction to six emotionally disturbed children: A case study approach. Dissertation Abstracts International, 1972, 32, 5071A.
This case study investigated the arithmetic achievement and attitude changes of six institutionalized emotionally disturbed children (ages 7-11). The children participated in an instructional program which dealt with the operations of addition and subtraction. A heirarchy of skills was developed for each operation. A diagnostic test was used to measure each child's understanding of those skills. The results of that diagnosis were used in the planning of instruction. Instructional activities centered around the manipulation of physical objects. The children displayed more positive attitudes toward their mathematical abilities and were able to master arithmetic tasks more rapidly after participating in this program.

(D. Ambrose)

Jones, R.C., Maertens, N.W. & Hotchkiss, J.M. A diagnostic and activity based arithmetic program for emotionally disturbed children. Monograph No. 5

University of Oregon, 1971. (ERIC Document Reproduction Service No. ED 057 547)

This report describes a program designed by Jones, Maertens, and Hotchkiss for teaching the operations of addition and subtraction to six emotionally disturbed children. The report includes a survey of related literature, an explanation of the program, and detailed case study reports of each of the six children and their progress in the program. Appendices include hierarchies of mathematical skills developed for this program, behavioral objectives for each skill, and diagnostic instruments for measuring arithmetic achievement and attitudinal changes among the children.

(D. Ambrose)

Jordan, J.H. Kelley's problems - A case study. Focus On Learning Problems in Mathematics, 1981, 3(1), 33-41.

This article is a case study of an eleven year old girl, Kelley. Detailed procedures for diagnosis and remediation of (a) the understanding of number (b) the memorization of addition facts and (c) the use of the subtraction algorithm are outlined. Concrete materials are emphasized in the remediation process.

(D. Simon)

Kaliski, L. Arithmetic and the brain-injured child. Arithmetic Teacher, 1962, 9, 245-251.

The author lists the following 12 symptoms found in brain-injured children in a classroom situation: fluctuating attention; perceptual disturbances; figure background confusion; distortion of body image; visual and motor incoordination; disturbed spatial, size, sequence, temporal relationships; motor disinhibition; left-right confusion; perseveration; language disabilities; deficient conceptualization; need for concreteness.

She points out how each symptom is specifically related to arithmetic learning. She suggests concreteness in teaching method and says the following techniques should be employed: multi-sensory techniques; relevance to everyday situations; graphic representation; stress interrelationships between operations; use of an oral language base.

Kaliski, L. Teaching mathematics to the child with specific learning disability. Focus on Learning Problems in Mathematics, 1979, 1, 60-73.

This article points out teaching methods to be used when dealing with S.L.D. children of "normal" intelligence who have difficulty understanding mathematical symbols. It points out the close relationship between math and language and the need for teaching methods which include motor activity, tactile approaches, visualization, vocalization and repetition of math sentences and procedures for a thorough undestanding of a given concept. The author feels more effective teaching takes place wherever class attention is focused on one teacher/one student performing a given task with total class participation taking place only in the form of

repetition of terms, sentences, procedures, etc. The need to stress the importance of what is termed "living mathematics" in the classroom is also mentioned as a way of enabling the S.L.D. child to become more aware of the world around him or her. Throughout the article are suggestions for teaching such concepts as addition, fractions, multiplication, measurement and telling time.

(A. Perales)

Kephart, N. The slow learner in the classroom. Columbus, Ohio: Charles E. Merrill Publishing Company, 1960.

This book addresses two competencies required of the teacher of the slow learner: A rationale which permits consistent interpretation of the child's learning behavior and a repertory of techniques by which information can be presented in myriad ways. The basic assumption is that the slow learner's central nervous system is operating in an aberrant manner. Thus, repeating a classroom presentation, drilling harder or going slower will not help. The slow learner requires a different kind of presentation, one in which the alterations in his processing will not interfere with the understanding of the material being presented.

Part I of the book presents a rationale for learning based on two primary principles: development and generalization. In Part II a series of techniques related to successive steps in the rationale are described. It is stressed that these are only examples, not a complete list of techniques.

(F. Fennell)

Kevra, B., Brey, R. & Schimmel, B. Success for slower learners, or Rx: relax...and play. Arithmetic Teacher, 1972, 19, 335-343.

Provides a list of 22 characteristics and compares "ambitious slow learners" with "unmotivated slow learners" on each characteristic. Stresses the importance of providing activities which are meaningful, give immediate gratification and enhance the learner's sense of personal worth. Various activities at the concrete level, and the abstract level are described. The need for careful concept development in order to lessen the need for retention of a vast number of unrelated facts and to equip pupils to solve problems in a variety of ways is stresses. Slow learners must have material that is simple, relevant, high in interest, and free from unnecessary terminology, and that simple achievable goals lure them to succeed.

(K. Hodgin)

Kilian, L., Cahill, E., Ryan, C., Sutherland, D. & Tacetta D. Errors that are common in multiplication. Arithmetic Teacher, 1980, 27(5), 22-25.

The authors report on a study made of 3294 multiplication examples of 121 students from 6 classes in 6 schools located in New York state. Errors made on the multiplication algorithm were classified as (1) calculation errors, (2) procedural errors, (3) errors that could not be classified. Fifty-six

percent of the errors were classified as procedural errors involving zeroes and carrying, and calculation errors involving facts of tables over five were most frequent.

(K. Hodgin)

King, D.T. An instructional system for the low-achiever in mathematics: A formative study. Dissertation Abstracts International, 1972, 32, 6743A.

A curricular unit on number theory using the paradigm of an instructional systems approach was developed to test the feasibility of promoting greater achievement and more positive attitudes toward mathematics for low achieving ninth grade students. The treatments were three instructional strategies: mastery learning (ML), mastery learning and flowcharting (ML + FC), and mastery learning, flowcharting and computer access (ml + fc + ca). A non-equivalent control group design was selected to test the instructional unit (ISLAM). On a posttest that measured mastery of ISLAM objectives, the Treatment Groups showed significantly superior performance ($p < 0.001$). Among treatment groups, the ML + FC group scored significantly higher than the other two groups.

(F. Fennell)

Kohn, M. Diagnostic and Prescriptive Program in Reading and Mathematics for 300 Title I Eligible Handicapped Pupils. (ERIC Document Reproduction Service No. ED 138 662)

A program for supplemental remedial instruction for handicapped children ages 6-14. Diagnostic-prescriptive approach was used and credited with very successful gains.

(A. Graeber and K. Baxter)

Kosc, L. To the problem of diffuseness in terminology in the field of disturbances and disorder of mathematical abilities. Focus on Learning Problems in Mathematics, 1980, 2(4), 79-83.

In this article, Kosc offers a critical review of an article written by W.K. Levy which appeared in an earlier edition of Focus on Learning Problems in Mathematics (vol. 1, no. 3, pgs. 41-51) titled "Dyscalculia: Critical analysis and future directions." Apparently, Levy referenced Kosc in his article and Kosc disagrees with Levy's interpretation.

(V. Amburgey)

Kraner, R.E. Math deficits of learning disabled first graders with mathematics as a primary or secondary disorder. Focus on Learning Problems in Mathematics, 1980, 2(3), 7-27.

In this study, the researcher individually tested 33 resource and 30 average children with the Kraner Preschool Math Inventory and the Kraner Test of Mathematics Master, Level I. The results of these tests were used to answer three specific questions: 1) What are the specific math skills/concepts which are deficient in a total learning disabled population? 2) What are the differences in learning deficits of learning

disabled students who are identified as primary or secondary math disordered (PMD or SMD)? 3) What are the patterns and trends of deficiencies of PMD and SMD students? The author concludes with the general findings, major constraints, and implications of this study.

(V. Amburgey)

Krapp, R.P. The diagnosis of achievement deficiency. National Association of Secondary School Principals, 1961, 45 (265), 84-87.

Discusses the problems of the educational counselor in ascertaining whether a student is actually failing to achieve according to his ability. Two conceptions of underachievement are discussed, an adjustment conception and a mental process conception. The adjustment conception views underachievement as a function of social and emotional problems which divert attention from schoolwork; the remedy is to identify and resolve the emotional problems. The mental process conception views underachievement as a function of deficiencies in mental processes that are used in apprehending content to be learned; the remedy is to appraise the content known by the student and his or her ability to manipulate that content with the mental process skills as listed in Bloom's Taxonomy of Educational Objectives: knowledge, comprehension, application, analysis, synthesis, and evaluation. Instruments are not available to assess the deficiencies and skills adequately, and the process involved in diagnosing and remediating deficiencies are uncultivated. Such a complex area requires the skills and abilities of highly trained specialists; yet at this time no collegiate training program is designed specifically to prepare people to work in this area.

(K. Hodgin)

Krautheim, J.J. Development of a framework for diagnostic teaching. Dissertation Abstract International, 1972, 32, 4490A.

The purpose of this study was to implement a framework for diagnostic teaching. An analysis of student responses to a diagnostic test, a training program to develop teachers' competencies in evaluating student responses and in prescribing instruction based on demonstrated learning readiness, and a developmental study to examine the framework for diagnostic teaching were completed. The content area was the operations of fractions; sixth grade students and teachers comprised the sample. The procedures were divided into five tasks, each treated as a phase of the study. Though there was some disagreement between an investigator and teachers and among teachers as to appropriate diagnosis and prescription, a comparative analysis indicated a significant difference between a diagnostic and a regular classroom. A cognitive task-stages of mastery hierarchy matrix provides scope and sequence of diagnostic teacher training and has implications for other areas of educational research.

(F. Fennell)

Lane, G.L. "Some experience with slow learners." Mathematics Teacher, 1974, 67, 67-69.

From his experience teaching slow learners, the author offers suggestions for motivating students by including easier, more practical and more interesting topics. In addition to finger multiplication, music to assist in memorization of basic facts, and contests, examples of unsloved problems and new developments in mathematics are given as a means of arousing interest. The author believes that when students become interested and start asking questions, they will learn some mathematics in spite of themselves.

(K. Hodgin)

Lepore, A.V. A comparison of computational errors between educable mentally handicapped and learning disability children. Focus on Learning Problems in Mathematics, 1979, 1(1), 12-33.

This is a study designed to analyze errors in the four areas of computation with whole numbers made by the mentally handicapped and learning disability children. Its purpose was to observe the similarities and differences of the errors made by the two groups. The results found that the types of errors made were not unique to the type of disability but were more associated with the mental age of the child.

(P. Lee)

Lerner, J.W. Children with learning disabilities: Theories, diagnosis and teaching strategies. Boston: Houghton Mifflin Co., 1971.

This book was intended to provide a comprehensive view of the field of learning disabilities. The book is organized around four parts, dealing with: 1) an overview of the field, 2) diagnostic-teaching, 3) theories and rationale for diagnostic teaching, 4) organization of programs. The author feels that both diagnosis and clinical teaching are necessary. The major emphasis of the book is on the development of teaching strategies.

(L. Stanley)

Levy, W.K. Dyscalculia: critical analysis and future directions. Focus on Learning Problems in Mathematics, 1979, 1, 41-51.

The article critically views the core of information common to dyscalculia investigations to illustrate the variance within the literature. The intent is to illustrate the lack of consensus which allows theorists support for widely divergent positions. Five problem areas were investigated. These problem areas were; estimate of incidence, nomenclature, definition of dyscalculia, symptomatology, and neurological correlates. Several suggestions—ranging from delineation between arithmetic and mathematics to research linking instructional methodology to type of mathematical disability—are made for further clarification of dyscalculia.

(M. Ratcliff)

Lyon, L. Math and focused energy. Focus on Learning Problems in Mathematics, 1981, 3(1), 43-46.

The value of attention skills for students with learning problems is discussed. An example of a diagnostic test to determine the effectiveness of attention skills is included and suggestions are made for meeting attention needs of the student.

(D. Simon)

McAloon, A. Some issues of concern in the development of a diagnostic testing program. From Proceedings of the third national conference on remedial mathematics, Kent, Ohio: Kent State University, 1976.

An outline is provided of important considerations for the development of a diagnostic testing program appropriate for use by classroom teachers. Questions must first be raised concerning the content — what objectives or skills are considered necessary. Development of a diagnostic test requires basically two steps: analysis of the complex performance into its component subskills, and making the test as free as possible from any other source of difficulty. Factors other than mathematical ability must be taken into account, i.e., emotional needs, maturity of the student, cultural background, etc. General criteria of tests are listed. It is assumed that as a group, elementary school teachers are inadequately trained in mathematics and educational measurement. We need to ask in what areas they need the most help, when that help can be given and by whom.

(K. Baxter and A. Graeber)

McAloon, A. Using questions to diagnose and remediate. Arithmetic Teacher, 1979, 27(3), 44-48.

Focused on the classroom setting, a variety of questions to probe understanding of arithmetic processes are presented along with selected examples of questions which expose misconceptions.

(C. Kochheiser)

McCully, R. Basic Skills Program in Phoenix. Mathematics Teacher, 1978, 71, (2), 113-116.

The Phoenix basic skills program was developed to establish a continuous uniform evaluation system for K-12 in computational skills without a major curriculum upheaval. The program included developing a criterion reference instrument and developing a good record keeping system for the program. The evaluative process revealed negative as well as positive aspects of the program.

(A. Leef)

Maan, P.H. & Suiter, P. Teacher's handbook of diagnostic inventories: Spelling, reading, handwriting, arithmetic. A practical guide with duplicating masters. Boston: Allyn and Bacon, 1976.

Although major emphasis is on reading skills, grade level sequences and developmental arithmetic inventory given. This book serves as practical

application of first text: Handbook in Diagnostic Teaching: A Learning Disabilities Approach.

Mary Jacqueline (Sister). An experiment in remedial teaching in arithmetic. Elementary School Journal, 1941, 41, 748-755.

Eleven seventh-grade children who had scored 72 percent or below on a reasoning test were selected for experimental remedial instruction to aid them to master the fundamentals of arithmetic and to gain power in problem analysis. Initially, the students were given a diagnostic test on the fundamental processes of addition, subtraction, multiplication, division, percentage, and problem solving. Remedial work was done outside the class period under supervision of the teacher. Oral drill was provided for fifteen minutes a day, focusing on development of a definite procedure to follow in attacking and solving arithmetical problems. The type of oral drill was chosen to prepare pupils for the written work, individual mistakes were noted, and individual remedial practice was given as needed. At the conclusion of the semester, the children were tested again and the scores showed that eight of the children made remarkable improvement while three pupils made little or no gain. As an experimental study this research is not carefully designed or conducted. The results point out Sister Mary Jacqueline's belief that abundant practice enabled the children to accumulate many facts, principles, and formulas and to have opportunities to apply and test these. Their success in performance of these tasks facilitated their learning and removed fear of attacking mathematics.

(K. Hodgin)

Matulis, R.S. A bibliography of articles on the teaching of mathematics in special education. Arithmetic Teacher, 1981, 28(7), 53-56.

A bibliography of 200 articles from 40 journals related to the teaching of mathematics to special education students. The bibliography is divided into sections on the characteristics of special students, general curriculum, instructional programs, including global approaches for setting up mathematics instruction for special students, games and materials and ways of motivating special students.

(B. Sadowski)

Nibbelink, W.H. The use of an anecdotal style of content presentation as a motivational and instructional device for seventh grade underachievers in mathematics. Dissertation Abstracts International, 1972, 32, 3185A.

A narrative and an accompanying workbook were the experimental package used for ten weeks. The study suggests that: 1) the experimental program is effective toward raising achievement level for seventh grade underachievers, 2) the experimental program is not less effective than the traditional program, and 3) underachievement, while unlike normal-achievement, becomes more clearly visible as task complexity increases.

(J.K. Scheer)

Oldaker, L.M. A study of the mathematics clinic as a clinical approach to inservice teacher education. Dissertation Abstracts International, 1976, 37, 1390A.

The effectiveness of a clinical approach for training inservice teachers in diagnostic-presciptive mathematics teaching was examined in this study. Specifically, Oldaker compared the extent to which diagnostic-prescriptive teacher behaviors had been implemented in classrooms of teachers who had received clinical training at Arizona State University (the treatment group) and teachers who had completed a graduate course in teaching elemetary school mathematics (the comparison group). A significant difference in the degree of implementation was found to favor the treatment group for types of materials used in mathematics teaching and for procedures for dealing with students who do not attain the concept.

(S.L. Young)

Olsen, C.R. The effects of enrichment tutoring upon self-concept, educational achievement, and measured intelligence of male underachievers in an inner-city elementary school. Dissertation Abstracts, 1969, 30A, 2404.

The study had two purposes: to investigate the effects of enrichment tutoring upon self-concept, educational achievement, and measured intelligence of male underachievers in an inner-city elementary school, and to asses the effectiveness of enrichment tutoring as viewed by the participating teachers in the school. Volunteer enrichment tutors were assigned to work with underachieving pupils in areas of academic and enrichment needs. Sixty second-, third-, and fourth-grade underachieving male pupils were stratified by grade level and randomly assigned to experimental and control groups. Tests were administered to both groups before and after treatment to asses changes in self-concept, educational achievement, and measured intelligence. Thirty-three statistical hypotheses were cast and comparisons were accomplished by analysis of covariance tests. The findings indicated that the tutored group positively and significantly exceeded the non-tutored group in social self-concept at the fourth-grade level, in language achievement at the second-grade level, and in other areas of self-concept, achievement and measured intelligence, no significant differences were found. Teachers reported that participating pupils had positive changes in self-confidence, self-attitudes, and self-worth, as well as improved study habits, grades, and reading.

(K. Hodgin)

Otto, W. & Koenke, K. Remedial teaching: Research and comment. New York: Houghton Mifflin Co., 1969.

This is a collection of reports and articles on remedial teaching. The book is subdivided into ten sections dealing with various aspects related to remedial teaching. The first half of the book deals with topics that are of general interest across the field. Many of the articles in these sections are related to reading. The second half of the book contains articles pertaining to specific subject areas. In the arithmetic section the papers are concerned

with IQ and personality traits of underachievers and superior students, problem solving, diagnosis, and individual practice in arithmetic.

(L. Stanley)

Peterson, Daniel L. Functional mathematics for the mentally retarded. Columbus, Ohio: Charles E. Merrill Publishing Co., 1973. 679 pages.

An outline of a functional mathematics curriculum, emphasizing developmental learning capacities and adult achievement potential of the retarded. In a list of principles of adaption, the author includes many which apply to pupils who are not retarded but are having difficulty learning mathematics. He builds upon these principles in the chapters on curriculum, the content of which is organized around eight mathematics categories: form and perception, vocabulary associated with mathematics, number symbols, cardinal numbers, ordinal numbers, measurement, money and value, number operations and problem solving. Objectives, teaching methods, and materials appropriate for the educable mentally retarded with chronological ages from three years through adulthood and for the trainable mentally retarded from primary to advanced levels are outlined. The discussion of each of the levels includes an overview of a developmental sequence of mathematical skills and a checklist for the level. A variety of ways to present each concept is discussed, with numerous examples of materials, both teacher-made and commercial, included. The author asserts that existing standardized tests are inadequate for the mentally retarded, so he includes directions for constructing informal number inventories based on a checklist for each level and examples of such inventories. His purpose of evaluation is to form a basis for making reasonable educational decisions for individuals. The mathematics for students at the senior high school level is aimed at developing social-vocational mathematics and consumer education, and contains suggestions for integrating measurement, money and value, problem solving, as well as other content areas, into these aims. Many of these ideas would be useful for a teacher working with older students in remediation efforts.

(K. Hodgin)

Phelps, C.L. A study of errors in tests of adding ability. Elementary School Teacher, 1913, 14, 29-39.

An analysis of the errors in addition made by eighth-grade students. In general, the number of errors increased with the size of the numbers in the problem.

(B. Sadowski)

Phillips, J. Mathematics: Rx for math. Instructor, 1972, 81, 58-61.

Describes three common causes of learning difficulties in math and offers suggestions for diagnosis as well as remediation of them. The three difficulties discussed are: 1) not understanding what is required in a given situation; 2) not having the concept of cardinal number; 3) not having the

concept of conservation of numerosity. The author suggests that many difficulties with math are essentially linguistic; if so, you teach in the same way you teach language. The child should be asked to show you and say what one is showing, not just tell you something. Also the child should be asked to predict a sensible answer, and to interpret results after the answer is secured.

(K. Hodgin)

Potter, M. & Mallory, V. Education in mathematics for the slow learner. Washington, D.C.: National Council of Teachers of Mathematics, 1958.
Published over twenty years ago, this pamphlet discusses the problem of slow learners in the high school, the characteristics of slow learners, and makes general suggestions on methods and materials to be used in teaching them. The suggestions are still viable for use with these students, and emphasis on the need for these students to have a competent teacher and courses which contain meaningful topics still needs to be made.

(K. Hodgin)

Rappaport, D. Gill, M.M. & Schafer, R. Diagnostic psychological testing. New York: International Universities Press, Inc., 1968.
Psychological testing is an effort to obtain whole and systematic samples of certain types of verbal, perceptual, and motor behavior in the frame of a standardized situation. This revised edition of Diagnostic Psychological Testing begins by introducing the reader to some of the best testing procedures psychology has to offer clinical psychiatric work. Following discussion on the nature of intelligence, review of the following tests and procedures is given: 1) The Wechsler-Bellevue Scale; 2) The Babcock Story Recall Test; 3) testing of concept formation; 4) The Sorting Test; 5) testing of personality and ideational content; 6) The Word Association Test; 7)The Roschach Test; and 8) The Thematic Apperception Test. Lastly, attention is given to diagnosing with a battery of tests.

(C. Trueblood)

Rees, H.E. Teaching division to reluctant learners. Mathematics Teacher, 1979, 72(8), 592-595.
This article demonstrates a technique for teaching division to tenth grade students who have a history of difficulty in mathematics. The process is based upon division as repeated subtraction.

(A. Leef)

Reisman, F.K. Diagnostic teaching of elementary school mathematics. Chicago: Rand McNally College Publishing Co., 1977.
Identifies elementary children's developmental level for math concepts. Diagnoses math difficulties of cognitive and affective nature. Prescibes, designs and sequences experiences for curriculum. Model for diagnostic teaching cycle given but very general.

Reisman, F.K. A guide to the diagnostic teaching of arithmetic. Columbus, Ohio: Charles E. Merrill Publishing Co., 1972.

This book deals with the question of why some children have difficulty learning arithmetic, and suggests some probable causes. It suggests that a diagnostic teaching strategy be used to teach arithmetic. The book then goes on to explain how diagnostic teaching can be incorporated into the classroom. Included in the book are sample lesson plans, mini-case studies, and an analysis of errors that elementary students commonly make in arithmetic.

(L. Stanley)

Riedesel, C.A. Guiding discovery in elementary school mathematics. New York: Appleton-Century-Crofts, 1967.

The purpose of this book is to provide pre-service and in-service teachers with some guidance on using a discovery approach in teaching elementary school math. It initially looks at the elementary mathematics curriculum; then takes each component of the curriculum and looks at ways of teaching that idea using a discovery approach. The book concludes with chapters on using media, and improving elementary mathematics.

(L. Stanley)

Riedesel, C.A. A diagnostic instrument for mathematics: The affective domain; a first step. From Proceedings of the third national conference on remedial mathematics. Kent, Ohio: Kent State University, 1976.

The author speculates that the lowering of math scores for both elementary and high school students may be at least partly related to the lack of social applications, games and general "fun" approach during the new mathematics era which in turn may have contributed significantly to a decrease in children's interest. A diagnostic instument was designed to assess the reasons for children's enjoyment or lack of enjoyment in working with mathematics. The 99-item questionnaire is based on the belief that if we can find the reasons for a child's disinterest in mathematics, we may be able to contribute to improved achievement. No data are presented; the questionnaire, included here, is offered for use by others with the hope that their responses will both refine and evaluate the instrument as a diagnostic tool.

(K. Baxter and A. Graeber)

Romberg, T.A. The application of "process evaluation" to corrective instruction: A suggestion. From Proceedings of the third national conference on remedial mathematics. Kent, Ohio: Kent State University, 1976.

The conventional deductive method of inquiry is not appropriate to the study of most corrective instructional events. It is suggested that "process evaluation" is a better methodology to be applied to corrective mathematics instruction; it is a descriptive and inductive search aimed at raising questions about an event rather than drawing conclusions. In

"process evaluation": effects are broadly conceived, for it is not realistic to focus on only one desired outcome; the time frame for data gathering includes pertinent information from before, during, and after the instructional event; descriptions of corrective instruction are constructed from the collected data; and interpretations are formulated from the descriptions to identify major relationships. "Process evaluation" expands the notion of effects beyond direct intended effects to a search for others that are unintended.

(A. Graeber and K. Baxter)

Romberg, T.A., Steitz, J. & Frayer, D.A. Selection and analysis of mathematics concepts for inclusion in tests of concept attainment. Madison, WI: Wisconsin Research and Development Center for Cognitive Learning, 1971. (Working Paper No. 55)

Mathematical nouns were identified by examing the mathematics textbooks used in a school district along with three other mathematics textbooks, and by consulting central office supervisors and teachers. The concepts identified were then placed into three major categories: concepts about sets, concepts related to division, and concepts which express relationships. Ten concepts were then randomly selected from each category for inclusion in tests of concept attainment. Based upon a logical analysis concept, items were written to test the attainment of each of the 30 concepts at 12 different levels. Analyses of the 30 selected concepts and illustrative examples of test items are presented in the paper.

(T. Romberg)

Romberg, T. A. (Ed.) Four studies on aspects of assessing computational performance. (Tech. Rep. No. 297) Madison, WI: Wisconsin Research and Development Center for Cognitive Learning, 1975.

This report documents four brief studies. The first involves the development of an oral speed test for arithmetic facts. The second is an investigation of three different response formats for a two-digit addition and subtraction test. The third study is on the effect of test item ordering on the performance of children of different test anxiety levels. The last is a comparative study of three remedial methods of instruction for two-digit addition with regrouping at the second grade. All of the three methods produced increased achievement. The calculator method, however, yielded the poorest results, and the traditional carrying method yielded the best.

(T. Romberg)

Romberg, T. A. The diagnostic process in mathematics instruction. Paper presented at the National Conference on Remedial Mathematics, Kent, Ohio, May, 1974.

This paper first clarifies the assumptions and steps in the diagnostic process in education; second examines a framework of how all teachers are expected to use the diagnostic process in school settings; and third,

discusses some of the important classroom illnesses related to mathematics instruction which have been identified during the past few years.

(T. Romberg)

Roseman, L. If you can count, you can add, subtract, multiply and divide any amount. Mathematics Teacher, 1978, 71(7), 564-566.

The article centers about a colorful periodic table which enables the student to use the four fundamental operations on whole numbers readily. A relatively simple but creative technique usable in class without a great deal of preparation.

(A. Leef)

Ross, R. R. A case study description of underachievers in arithmetic. Dissertation Abstracts, 1962, 22, 2294.

This study deals with underachievers in mathematics and the potential causes of such underachievement. Group as well as individual characteristics which contribute to underachievement are included in the study. The study indicated that underachievers often have a withdrawn and defeated attitude toward school, little intellectual stimulation from home, and usually are underachievers in other subject areas. Group results reflected satisfactory achievement in whole number addition and subtraction reasoning; and whole number addition, subtraction, and multiplication, only.

(G. Johnson)

Rowland, T. D. The relationship between anxiety and the disparity of reading and arithmetic achievement. Dissertation Abstracts, 1961, 21, 1088-9.

This is a study of the relationship between anxiety, measured by the Children's Manifest Anxiety Scale, and disparity of reading and arithmetic, measured by the Iowa Basic Skills Test. Disparity is defined as being the difference between arithmetic and reading standard scores. It was found that anxiety was not directly associated with disparity. Likewise an nonsignificant correlation was derived when testing the inverse relation between anxiety and disparity for underachievers as well as in the testing of higher levels of achievement influencing anxiety to cause greater disparity in favor of reading.

(G. Johnson)

Ruais, R. A low-stress algorithm for fractions. Mathematics Teacher, 1978, 71(4), 258-260.

The author uses Hutchings' definition of a low-stress algorithm and presents a binary ray method of teaching addition-subtraction of fractions. The precise development of the algorithm through a series of specific activities makes this a practical article.

(A. Leef)

Sadowski, B. R. Dissonance in arithmetic diagnosis. Focus on Learning Problems in Mathematics, 1981, 3(1), 25-31.

This article describes an example of dissonance, outlines levels of maturity in arithmetic concepts, describes how to structure an interview to generate a sense of dissonance, and then describes different reactions to the conflict and the implications for remedial instruction.

(D. Simon)

Sadowski, B. R. An investigation of the validity, accuracy and consistency of prescriptions derived from a domain-referenced diagnostic arithmetic test and interview protocols. Dissertation Abstracts International, 1979, 40.

An investigation of the Maryland Diagnostic Arithmetic Test as a valid instrument for group diagnosis in arithmetic, when used as a criterion referenced test of whole number computation, numeration concepts, problem solving concepts, sentence solving skill and concepts about the meaning of the operations. A majority of the domains tested were both reliable and homogeneous indicating diagnostic validity for the MDAT as a group administered disgnostic test. The analysis of the answers to the sentence solving section revealed two distinct patterns of responses which were hypothesized to be strategies which students follow in solving sentences.

(D. Simon)

Sadowski, B.R. Some suggestions for the construction of diagnostic arithmetic tests. Focus on Learning Problems in Mathematics, 1979, 1, 25-30.

There is always a problem coordinating commercially-made diagnostic tests and the particular objectives that are being taught in any given district or classroom setting. A teacher therefore has the option of creating his own diagnostic test which will focus on those objectives which are considered important. Several key points are important to remember. After determining the purpose of the test, design it to provide information on a limited number of concepts. Then decide which concepts are to be evaluated. Choose the best type of items for the purpose (e.g. multiple choice). Choose the number of items that will test each objective and how many items must be answered correctly to indicate mastery. If the items involve no guessing, then three out of four or five would indicate mastery. But if guessing is a factor then five out of seven would be more appropriate. By comparing results for students in a class, a teacher could then group students and focus on the individual needs of each group.

(F. Salinas)

Schact, E.J. A study of the mathematical errors of low achievers in elementary school mathematics. Dissertation Abstracts, 1967, 28, 920-921.

This 1981 study was designed to identify error patterns in mathematical computations of low achievers in elementary school, and to analyze the error patterns to determine the cause of the errors. Also included was an effort to determine the relationship between the pattern errors of the low

achievers and their intelligence, achievement in language and reading, sex, attitude toward mathematics, and teacher awareness. Implications for elementary school mathematics programs for low achievers were listed based on the conclusions of this study. They included using concrete materials for teaching concepts, relating math concepts to life situations implementing ungraded and individualized programs, and minimizing reading in math classes.

(G. Johnson)

Scheer, J.K. Effects of supplemental diagnostic/prescriptive teaching on mathematics achievement, attitude and self-concept. Dissertation Abstracts International, 1977, 38, 681A.

The main purpose of this study was to investigate whether participation in supplemental diagnostic/prescriptive mathematics activities is associated with changes in students' mathematics achievement, attitude toward mathematics, and self-concept in the classroom. A related concern was the extent to which the observed changes are maintained after the completion of this participation. There was a significant difference between the treatments and controls in mathematics achievement immediately following the supplemental diagnostic/prescriptive activities and six weeks afterward. Attitude increased significantly only after six weeks, and self-concept showed no significant differences at any time.

(J. Scheer)

Scheer, J.K. The etiquette of diagnosis. Arithmetic Teacher, 1980, 27(9), 18-19.

Scheer outlines 12 guidelines, or do's and don'ts, for use by teachers in diagnostic sessions with students. If used, the guidelines will help make diagnosis more effective and more accurate.

(K. Hodgin)

Schilling, F. A description of the development and implementation of a curriculum-materials package for teaching mathematics to low achievers. Dissertation Abstracts, 1969, 30, 1925-1926A.

A Systems Approach to Improving Mathematics Instruction (SAM) was developed for low achieving fourth graders. It was field tested in 18 Pittsburg public and parochial schools. Most teachers evaluated SAM very positively.

(R. Underhill)

Schoen, H.L. Using an interview to assess mathematics learning. Arithmetic Teacher, 1979, 27(3), 34-37.

Examples of how findings from interviews can be helpful in individual diagnosis, instructional planning for the classroom and evaluation of instructional programs; plus some guidelines for using interviews.

(C. Kochheiser)

School Mathematics Study Group. Conference on mathematics education for below average achievers. The Board of Trustees of the Leland Stanford

Junior University, April, 1964. Funded by USOE.
Report of a conference held to make recommendations for SMSG experimentation and curriculum development. The report contains seven papers, discussion summaries, and a transcript of a panel of reactors. The report concludes with suggestions and recommendations.

(R. Underhill)

Schultz, Karen A. & Strawderman, Virginia W. Diagnostic-presciptive mathematics teaching and the teaching cycle model. Focus on Learning Problems in Mathematics, 1980, 2(4), 27-36.
The authors propose an alternate diagnostic-prescriptive, procedure which is based on a hierarchy of learning behaviors and the concept of prerequisite learnings as suggested by Gagne. The model is designed for use by classroom teachers on a regular basis and to faciliate the teachers with decisions concerning individual instruction, small group instruction, or large group instruction.

(V. Amburgey)

Schumacher, D., Brown, F.E. and Dermott, A. A motivational mathematics course for underachieving high school students. Focus on Learning Problems in Mathematics, 1981, 3(1), 61-68.
A program designed to remediate mathematics avoidance and school failure in low income high school students is described. Students participating in the Upward Bound program at the University of Maine at Orono for six summers (1974-1979) consistently improved in basic math competencies, in attitude towards mathematics, and in total academic motivation.

(D. Simon)

Schwartz, F.J. The impact on learning of COLAMDA project materials on low-achievers in mathematics. Dissertation Abstracts International, 1972, 32, 3576A.
This investigation analyzed the impact of COLAMDA materials on the achievement level of the low-achiever in mathematics. Seventh and eigth grade students were selected from schools in the Metropolitan-Denver areas. Two teachers were utilized, one who had participated in a COLAMDA workshop and one who had not. The analysis of variance and analysis of covariance and the Newman-Keuls technique were used for the analysis of the data obtained from the evaluative instruments which were written for the educational objectives of the COLAMDA materials and the arithmetic sections of a Standardized Achievement Test. The subjects, who did not use the material obtained a significantly higher level of achievement than those who used the material.

(T. Barrie)

Scott, A.W. An evaluation of prescriptive teaching of seventh-grade arithmetic. Dissertation Abstracts, 1970, 30, 4696A.

The purpose of this study was to investigate the effectiveness of prescriptive teaching of arithmetic to seventh grade pupils who were achieving at least one year below grade level in mathematics. The twenty-five pairs of students selected scored in the lower quartile on all scales of the arithmetic section of a standardized achievement test. The subjects assigned to the experimental group received a concentrated seven week course on computation skills. Commercial programmed materials were also used. The control group returned to their regular classroom with no further special attention until the post test. The results indicated a significantly ($p < 001$) greater gain in computation skills for the experimental group, over the control group. No significant difference concerning concepts or application skills was found between the two groups.

(T. Barrie)

Sharp, F.A. One way to teach mathematics to the learning disabled child. Focus on Learning Problems in Mathematics, 1980, 2(3), 61-78.

The author describes sequences and activities for teaching concepts, such as, counting, addition, subtraction, money, place value, multiplication, division, word problems, etc.

(V. Amburgey)

Shaw, C.N. Effects of three instructional strategies on achievement in a remedial arithmetic program. Dissertation Abstracts, 1968, 29, 1479-1480A.

This study investigated the effects of three instructional strategies on arithmetic achievement which were drill, drill with feedback, and mixed drill. The materials were presented via CAI and were remedial in nature. The subjects were junior high school students whose scores on diagnostic tests showed they lacked computational skill in addition and subtraction. At the .05 level all strategies produced increases in scores on the immediate post-test. On the prerequisite and terminal objectives, the control group had no significant changes in scores while all treatment groups had higher scores. The delayed post-test did not produce higher scores for any of the groups on the prerequisite objectives but did produce higher scores on the terminal objectives. It was concluded that the mixed drill strategy was the best of the three strategies.

(T. Barrie)

Sherer, M.T. An investigation of remedial procedures in teaching elementary school mathematics to low achievers. Dissertation Abstracts, 1968, 28, 4031-4032A.

This study investigated the effectiveness of remedial materials and selected procedures to low achievers in grades three through seven. Forty-seven students were selected with IQ's between 92-108 and arithmetic

computation scores which indicated at least one year retardation. A control group and two experimental groups were formed. Students of the control group had only classroom instruction and twenty forty-minute tutoring lessons, in which materials which varied in nature were used. The pre-test and post-test of the Los Angeles Diagnostic Test: Fundamentals in Arithmetic-Form I and the preattitude and post-attitude toward arithmetic by the Dutton Attitude Toward Artithmetic Scale for pupils and tutors were used. The study indicated that the experimental groups showed a greater gain of achievement over the control group and a more favorable attitude.

(T. Barrie)

Simpson, P.A. A duplication method of long division. Mathematics Teacher, 1978, 71(8), 646-647.

This article written for a general mathematics class, demonstrates a method of presenting long division which does not require multiplication or division in the procedure. The author's explanation is explicit and this contributes an alternative technique to the classroom teacher.

(A. Leef)

Skarbek, J.F. Diagnostic analysis of mathematics skills. In The slow learner in mathematics, the Thirty-fifth Yearbook of the National Council of Teachers of Mathematics. (W.C. Lowry, et al., Eds.) Washington, D.C.: National Council of Teachers of Mathematics, 1972.

In order to illustrate oral analysis as a diagnostic technique in determining mathematical skills, the explanations of four fourth-grade students, as each performed a subtraction task, are given. The computations are reproduced as they appeared on the children's papers. In each case, the author diagnoses the student's work and indicates when further questioning is needed.

(K. Baxter and A. Graeber)

Skemp, R.R. The psychology of learning mathematics. Baltimore, Md.: Penguin Books, 1971.

The first part of this book is designed to answer the question, "What is understanding?" and is mainly concerned with psychology: In the second part he applies the psychological findings to certain basic concepts in mathematics, e.g., sets, systems of numeration, numbers, equivalence, and mathematical models.

(T. Romberg)

The slow learner in mathematics: Thirty-fifth yearbook. Washington, D.C.: National Council of Teachers of Mathematics, 1972.

In this yearbook the slow learner is any student who is achieving below an acceptable level. The major emphasis of the book is on providing ideas for classroom use with the slow learner including research, the characteristics and needs, and creation of a favorable learning environment. The middle

section deals with specific ideas for use in the classroom. The last chapters are on administration. Appendix A contains activities and games for use with the slow learner. Appendix B consists of sample lesson plans.

(L. Stanley)

Smith, C.W. Jr. A study of constant errors in subtraction and in the application of selected principles of the decimal numeration system made by third and fourth grade students. Dissertation Abstracts International, 1969, 30A, 1084.

Students in two third grade and fourth grade classes from each of two schools whose fourth grade Iowa Tests of Basic Skills mean composite scores were below grade level and similarly from classes in schools above grade level were administered a Subtraction Diagnostic Test and a Place Value Test. Performance on subtraction and place value tests are correlated. Pupils who correctly applied selected decimal numeration principles made few subtraction errors. Pupils proficient on the renaming subtests had less difficulty in subtracting than those less proficient. Errors committed most frequently by students who applied decimal numeration principles correctly were related to basic subtraction combinations, subtracting the minuend from the subtrahend, and writing zero as an answer instead of borrowing.

(T. Romberg)

Smith, R.F. A diagnostic study of pupil performance on a test of skills relevant to the mastery of place-value tests. Dissertation Abstracts International, 1972, 33A, 87-88.

The purpose of this study was to identify those skills relevant to the mastery of place-value tasks involving hundreds, tens, and ones that are difficult for primary grade children. Six tests were constructed by the investigator: a Place-Value Mastery Test and five Place-Value Diagnostic Tests. The mastery test was used to identify two groups of students: those who had and had not successfully mastered place-value tasks. The diagnostic tests were designed to identify subordinate skills. The study was on 323 second-grade pupils (split into 2 groups) in four parochial schools. Results show High Achievers were significantly higher on all tests than the scores for Low Achievers. Performance on the mastery test was related to the mastery of subordinate skills.

(T. Romberg)

Snellgrove, J.L. A study of relationships between certain personal and socio-economic factors and underachievement. Dissertation Abstracts, 1961, 21, 1859.

The purpose of this study was to determine what relationships, if any, exist between personal and socio-economic factors and underachievement of high school students at both junior and senior high school levels. The testing of the hypothesis was accomplished by administration of the

California Test of Personality; Fields-of-Study Motivation Record; and a questionnaire. A sample of 196 pupils was tested. The conclusions are: there is a larger number of males who are underachievers than females; grades and scores on the motivation test are positively correlated; the underachievers scored below the CTP test norms on Personal, Social, and Total Adjustment; personality malajustments decreased from the seventh through the twelfth grades. Differences between responses of underachievers and those of a control group on the questionnaire related to college careers were not significant; underachievers do not identify more with other underachievers than they do with individuals outside this group; and an individual who sets up an occupational goal earlier in school is not less likely to underachieve than one who does not set up this goal.

(T. Romberg)

Speer, W.R. A clinical model for diagnosing mathematical deficiencies incorporating educational cognitive style. Dissertation Abstracts International, 1977, 37, 6327A.

The purpose of this study was to create a theoretical model for the clinical diagnosis of mathematical deficiencies – a model which is compatible with the three factors of mathematical diagnosis, mathematics style, and educational cognitive style into a model which can be used in a prescriptive sense to determine the most probable means of providing successful corrective teaching. The "identification of specific mathematical deficiencies" refers to the process of determining, by various forms of examination, the specific nature and circumstances of a more general, suspected deficiency. "Mathematics style" is viewed as the manner in which an individual operates on the concrete–representative–abstract hierarchy in light of mediating variables encountered in both the mode of presentation and type of desired student response. "Educational cognitive style" refers to the way in which an individual takes on meaning, the way in which an individual can master an educational task most readily.

(V. Amburgey)

Speer, W.R. A clinical model for diagnosing mathematical deficiencies, (MD) 2 Incorporating educational cognitive style. Paper presented at the annual meeting of the American Educational Research Association, New York, New York, April 4-8, 1977. (ERIC Document No. 142 401).

This paper discusses a model for the diagnosis of mathematical deficiencies incorporating the three factors of mathematical diagnosis, mathematical style, and educational cognitive style. To accomplish the creation of this model, research in four interrelated areas was examined: (1) model theory, (2) psychology of mathematics learning, (3) cognitive style in psychology, and (4) diagnosis and diagnostic testing in mathematics. This model may be used, also, for prescription purposes in order to determine the most probable means of providing successful corrective teaching.

(V. Amburgey)

Speer, W.R. "Do you hear what I hear?" A look at individual learning styles. Arithmetic Teacher, 1979, 27(3), 22-26.

Each child enters the classroom with a different set of learning styles. An awareness of these various styles will assist in understanding the individual differences in the ways that students approach and conceptualize material. The author describes educational cognitive style in three components: (1) "symbolic orientations", (2) "cultural determinants", and (3) "modalities of inference". Educational cognitive syle is a means of identifying the ways in which an individual perceives and reacts to his or her environment and is determined by the way a student tends to seek meaning and the manner in which information is personally filtered. The diagnostician must not only diagnose the student but also those tasks that may be used in subsequent instruction.

(V. Amburgey)

Steeves, J. Multi-sensory math: An instructional approach to help the LD child. Focus on Learning Problems in Mathematics, 1979, 1, 51-61.

Rather than attempt to define or explain learning disabilities, this report suggests teaching methods and strategies that will help the child overcome the difficulties he or she experiences. The author points out that the majority of teachers want less information about the etiology of learning disabilities, and more about alleviating the difficulties. She proposes a multi-sensory approach to allow the L.D. child to make use of the sense modality through which he or she learns most comfortably and efficiently. Suggestions are made for multi-sensory applications in the following aspects of mathematics: games, counting activities, Chisanbop, blackboard work, number facts, mental arithmetic, new concepts, fractions, decimal fractions, oral work, and review. Further, the author recommends teacher or student-made materials which she believes are equal or superior to commercially produced materials. Producing their own materials gives students an additional sense of participation and is consistant with a multi-sensory approach. In conclusion the author emphasizes the importance of teacher enthusiasm and the need for varied activities and a multi-sensory approach to ensure a continuous learning situation in the classroom.

(M. Watson)

Stenquist, J.L. The administration of a program of diagnosis and remedial instruction. In Educational diagnosis, the Thirty-fourth Yearbook of the National Society for the Study of Education. Bloomington, Ill.: Public School Publishing Co., 1935.

Emphasis is placed on the need for education to be responsive to the wide variation among children, in order to insure that all pupils will receive equal opportunity. An effective program of diagnosis, under capable leadership, is essential to this end. It should be characterized by: (1) good organization of personnel, guided by a common philosophy; (2) a research program, which includes teachers and administrators, to keep up with new developments and to guide the diagnostic work of the schools; (3)

administrative measures that facilitate diagnostic teaching; (4) teacher-training; (5) selection of good instructional materials; (6) careful record-keeping.

(K. Baxter and A. Graeber)

Swize, L.M. The relationship between performance on Piagetian conservation tasks and intelligence and achievement in educable mentally retarded children. Dissertation Abstracts International, 1972, 32, 3806A.

The purpose of this study was to determine the relationship between performance on a standardized test of conservation; including conservation of two-dimensional space, number, substance, continuous quantity, weight, and discontinuous quantity; and intelligence and achievement in a sample of educable mentally retarded children, from nine to fourteen years old.

(B. Stevens)

Tarnopol, L. & Tarnopol, M. Brain function and arithmetic disability. Focus on Learning Problems in Mathematics, 1979, 1, 23-39.

The authors have presented a study of dyscalculia, a condition whereby a person with reasonable intelligence experiences difficulty learning arithmetic. The 277 students used in the study are those with no known brain damage. Three measuring instruments were used in the study in order to correlate arithmetic achievement and brain functions. Both the arithmetic and spelling subtests of the Wide Range Achievement Test (WRAT) and the Wide Range Vocabulary Test (WRVT) were used to measure quantitative knowledge and verbal skills. The Developmental Test of Visual Motor Integration (DTVMI), which consists of copying geometric designs, was used to measure brain function.

(M. Cameron)

Thelen, H.A. The evaluation of group instruction. In Educational evaluation: New roles, new means. The Sixty-eighth Yearbook of the National Society for the Study of Education. (R.W. Tyler, Ed.) Chicago: The University of Chicago Press, 1969.

Diagnosis is part of all instruction, but its purposes and strategies differ, depending on the nature and expectations of the classroom group. Three basic views of classrooms are described: (1) collectivity, where children are taught essentially the same things at the same time; diagnosis attempts to ascertain where individual students stand with respect to specific learning goals. (2) An interpersonal network, where children are seen in more individual terms; diagnosis considers the private needs that may be diverting the individual's energy away from required tasks. (3) A microsociety: diagnosis is concerned with full functioning of everyone. In the author's view, only the vision of the classroom as a microsociety can deal with the student in all of these roles — as learner, individual, and as group member. If we accept the concept of the classroom as an educative community, then diagnosis can describe situations with which individuals can cope, rather

than just measure fragmentary skills that are assumed to meet everyone's needs.

(K. Baxter and A. Graeber)

Thornton, C.A. Basic fact mastery: guides to success for the LD child. Focus on Learning Problems in Mathematics, January 1979, 1 (1), 34-42.
This article concerns ways to help the LD and other children utilize thinking strategies and relationships among number combinations in mastering basic arithmetic facts. It gives a summary of two research studies with suggestions for teaching the LD child. The two studies included are: (1) Case Studies of LD Students in One-on-one Setting and (2) Students Mainstreamed in Regular Class Mathematics. The article concludes with a list of quidelines to fact mastery.

(M.A. Alexander)

Tomlinson-Keasey, C. Integrating concepts and numbers. Focus on Learning Problems in Mathematics, 1980, 2(1), 61-71.
The author makes the point that students who do not have concepts such as one-to-one correspondence, seriation, classification, and reversibility will experience difficulties in math. Therefore, the teacher should be aware of these concepts and attempt to integrate them into the child's conceptual framework.

(V. Amburgey)

Trueblood, C.R. A goal-referenced diagnostic model for individualizing instruction. In Remedial mathematics: Diagnostic and prescriptive approaches (Higgins and Heddens, Eds.) ERIC/SMEAC #251M.

Tyler, R.W. Characteristics of a satisfactory diagnosis. In Educational diagnosis, the Thirty-fourth Yearbook of the National Society for the Study of Education. Bloomington, Ill.: Publishing School Company, 1935.
Effective diagnosis must have worthwhile objectives, validity, and reliability; it must provide comparable data and sufficiently exact data; it must be comprehensive, practicable, reasonably objective, appropriate to the program, carried to a satisfactory level of specificity, and conducted by qualified people. These characteristics are viewed as essential in evaluating learning abilities in general; mathematics is not singled out for discussion except in a reference to the diagnostic tool of interviewing.

(A. Graeber and K. Baxter)

Underhill, R.G. A diagnosis position paper: General needs and hierarchies. In Proceedings of the third national conference on remedial mathematics. (Heddens, J.W. & Aquila, F.D., Eds.) Kent, Ohio: Kent State University, 1976.
In the first part of this paper, the need for defining diagnostic vocabulary and identifying assumptions is discussed. Several sources and alternatives

are suggested. In part two are discussed some issues related to research on hierarchies.

(R. Underhill)

Uprichard, A.E. Suggested directions for clinical research in mathematics education in Proceedings of the third national conference on remedial mathematics. (Heddens, J.W. & Aquila, F.D., Eds.) Kent, Ohio: Kent State University, 1976.

The author offers citations from eight major research reviews to indicate research needs in mathematics education and curriculum development. The primitive state of the art was presented. Following suggestions made by Cronbach seven suggestions were offered for implementing clinical research.

(R. Underhill)

Uprichard, A.E., Baker, B., Dinkel, N. and Archer, C. A task-process integration model for diagnosis and prescription in mathematics. Unpublished paper, University of South Florida, 1975.

This paper describes a diagnostic/prescriptive mode for use in teaching mathematics. It provides a rationale for the model and includes illustrations of how to use it. The model represents a synthesis of the task analysis and the ability training models.

(C. Goodall)

Wallace, G. & Larson, S.C. Educational assessment of learning problems: Testing for teaching. Boston: Allyn and Bacon, Inc., 1978.

The early chapters present an overview and principles of educational assessment. Chapter 12 focuses specifically on arithmetic assessment. Included is a short discussion of causes of arithmetic problems as well as descriptions of formal and informal assessment techniques.

(L. Callahan)

Washbon, C.A. The development and application of a model for clinical intervention research in mathematics education. Master's Thesis, University of Maryland, 1975.

A clinical intervention case study of a child diagnosed as having visual perception problems. The child's perceptual problems interacted with pictorial displays involving the space down the main diagonal in a rectangular array of square regions which represent a family of addition facts for a given sum.

Waugh, K.W. & Bush, W.J. Diagnosing learning disorders. Columbus, Ohio: Charles E. Merrill, 1971.

The book is a text in diagnosing learning disorders. It proposes to help one identify major learning disorders relative to behavior, to then suggest the use of data for a diagnosis for remediation. It seeks to bridge the gap between the teacher and the consultant relative to student emotional and

learning disorders. Case studies are used to translate the diagnostic data into teaching-learning process. It is designed for use at both the graduate and undergraduate levels.

(C. Goodall)

Webb, J.R. & Webb, L.F. Are we traitors to our own cause? Focus on Learning Problems in Mathematics, 1980, 2(2), 15-25.

The authors present five challenges to the reader concerning common computational error patterns by students. The reader is an active participant by analyzing the problems in order to identify the error pattern. Then, the reader is given room to describe the pattern and some solutions for remediation. Afterwards, the authors provide their interpretations and suggestions.

(V. Amburgey)

Weidner, S.K. Case study of the arithmetic problems of a child with severe left-hemispheric brain damage. Focus on Learning Problems in Mathematics, 1980, 2(1), 45-52.

The author describes some specific math difficulties of a student, aged 9 years 9 months, who had suffered a severe injury to the left hemisphere of his brain due to a car accident at the age of 3½ years. Remediating activities that were used successfully with him are also described.

(V. Amburgey)

Weill, B.F. Mrs. Weill's hill: A successful subtraction method for use with the learning-disabled child. Arithmetic Teacher, 1978, 26(2), 34-35.

A combination of adding-on and going through ten to provide a unique method of having children learn to compute accurately with subtraction facts with minuends between 11 and 18. The technique provides a good way to approach the child who believes that subtraction facts like these cannot be done because he has only ten fingers.

(B. Sadowski)

Whipple, G.M. (Ed.) Educational diagnosis. The 34th Yearbook of the National Society for the Study of Education. Bloomington, Ill.: Public School Publishing Company, 1935.

An entire yearbook devoted to a) factors associated with learning difficulty, b) principles and techniques of diagnosis, c) diagnosis and instruction related to specific subject fields, d) diagnosis and treatment related to other objectives of instruction and e) administration of diagnostic and remedial programs. Though dated, an excellent treatise with a great deal of valuable information.

(L. Capps)

Whitcraft, L.H. Remedial work in high school mathematics. Mathematics Teacher, 1980, 73, 51-60.

This article is reprinted from the January 1930 issue of The Mathematics

Teacher. It offers an interesting view of diagnostic and prescriptive teaching suggestions of 50 years ago and contains discussion of "definite ends" (objectives) and of the role of drill. "Referring to a model" is suggested as a good method for teaching; the 'model' is a sample problem and its complete solution which the student can follow and use to identify his own errors. The author suggests procedures to determine where remedial work is needed and remedial material which may be used. He advises recording in a chart the type of error a pupil is making and what he should do to overcome it. The list of common errors from a study of a ninth grade algebra class includes errors in simple arithmetic, signs, copying and reading, incorrect operations, and lack of understanding of terms. These five error types which made up 85.4% of the total number of mistakes in the study are still very familiar to algebra teachers today. Diagnostic and remedial techniques similar to those suggested fifty years ago are still being proposed and practiced today.

(K. Hodgin)

Williams, J.D. Some peculiarities of calculative thinking and their consequences. In William E. Lamon (Ed.) Learning and the Nature of Mathematics. Chicago: SRA, 1972.

Because of the abstractions, hierarchal nature of mathematics and required precision of mathematics, many children who could succeed in mathematics fall victim to a "thought block". The resulting "number neurosis" results in a student's failure to study the subject. Remediation requires helping the student see the meaning of mathematical symbols and their manipulation.

(G. Burton)

Wilson, J.W. Diagnosis and treatment in arithmetic: Beliefs, guiding models and procedures. 1976. Available through the Umporium, University of Maryland, College Park, Maryland.

A brief book on the models and procedures for diagnosis and remediation developed and used at the Syracuse University Arithmetic Clinic and University of Maryland Arithmetic Clinic. Instructional models such as the activity type cycle and content taxonomy provide direction for sequencing remedial instruction. The exemplar matrix and cross-class translation matrix clarify the range of diagnostic procedures that may be used in diagnosing children's difficulties in arithmetic. Suggestions for examing relevant and irrelevant attributes of place value exemplars are useful in choosing materials for remediating children in numeration concepts. Ideas about levels of maturity and modification of materials for learners with disabilities are also presented.

Wilson, J.W., Sadowski, B., Washbon, C., Johnson, M. & Ashlock, R. Some findings of and futures for clinical research in mathematics education. Panel presentation at National Council of Teachers of Mathematics, Boston, 1979. (ERIC Document Reproduction Service No. 134-278)

Transcriptions of papers presented on the application of clinical intervention research in the areas of diagnosis, instructional procedures

and curriculum specifications. An introduction to clinical intervention research is given and a case study of clinical intervention research is included.

INDEX

Items in the index are grouped under the following categories. Italicized entries are found in the 1979 Annotated Bibliography of Periodical Articles Relating to the Diagnostic and Prescriptive Instruction of Mathematics.

- Anxiety
- Attitudes
- Diagnosis
  - Clinical
  - Error Patterns
  - General
  - Testing
- Gender Differences
- Hierarchies/Sequencing
- Mathematics Learning
- Miscellaneous
- Remediation
  - Classroom Techniques
  - General
- Teacher Education

Altinger, J., p. 1.
Alpert, R., & Haber, R., p. 1.
Castenada, A., Palermo, D.S., & McCandless, B. R., p. 7.
Donady, B., & Tobias, S., p. 14.
Dreger, R. M., & Aiken, L., p. 15.
Gough, Sister M. F., p. 19.
Hill, K.T., & Eaton, W. O., p. 21.
Lazarus, M., 1974, p. 23.
Lazarus, M., 1975, 41, p. 23.
Lazarus, M., 1974, p. 23.
Mitzman, B., p. 25.
Morris, L. W., Kellaway, D. S., & Smith, D. H., p. 26.
Ohlson, E. L., & Mein, L., p. 28.
Richardson, F. C., & Suinn, R. M., p. 32.
Rowland, T. D., p. 43.
Schwartz, R. H., p. 37.
Siu, M-K., p. 38.
Suinn, R. M., & Richardson, F., p. 39.
Szetela, W., p. 40.
Tobias, S., p. 40.
Tulock, M. K., p. 41.
Williams, J. D., p. 56.

ATTITUDES

Aiken, L. R., p. 1.
Bachman, A. M., 1970, p. 2.
Bachman, A. M., 1971, p. 2.
Bassham, H., Murphy, M., & Murphy, K., p. 2.
Cech, J. P., p. 8.
Feldhusen, J. F., Denny, T., & Conden, C. F., p. 17.
McMillan, J. H., p. 24.
Neale, D. C., p. 27.
Plank, E. N., p. 31.
Poffenberger, T., Norton, D., p. 31.
Riedesel, C. A., p. 41.
Scharf, E. S., p. 36.

DIAGNOSIS – CLINICAL

Alexander, D. W., p. 1.
Ashlock, R. B., Wilson, J. W., & Hutchings, B., p. 2.
Brownell, W.A., p. 6.
Brueckner, L. J., p. 6-8.
Copeland, R. W., p. 15.
Gunderson, A. G., p. 26.
Johnson, M. L., p. 29.
Lankford, F. G., Jr. p. 23.
McAloon, A., 1979, p. 36.
Melton, J., p. 24.
O'Brien, T. C., & Richard, J. V., p. 28.
Pincus, M., et al., p. 30.
Romberg, T. A., 1976, p. 41.
Sadowski, B. R., 1981, p. 44.
Schoen, H. L., p. 45.
Skarbek, J. F., p. 48.
Washbon, C. A., p. 54.
Weaver, J. F., 1955, p. 43.

DIAGNOSIS – ERROR PATTERNS

Ashlock, R. B., p. 2.
Brown, J. S., & Burton, R. R., p. 5.
Brown, J. S., et al., p. 5.
Brueckner, L. J., p. 6-8.
Brueckner, L. J. & Elwell, M., p. 9.
Cox, L. S., p. 11.
Ellis, L. C., p. 20.
Englehardt, J. M., & Weibe, J. H., 1981, p. 21.
Guiler, W. S. p. 26.
Kilian, L., et al., p. 32.
Lepore, A. V., p. 35.
Morton, R. L., p. 26.
Phelps, C. L., p. 39.
Reisman, F. K., p. 32.
Roberts, G., p. 33.
Schact, E. J., p. 44.
Smith, C. W., Jr., p. 49.
Webb, J. R., & Webb, L. F.
West, T. A., p. 44.

DIAGNOSIS – GENERAL

Baur, G. R., & George, L. O., p. 3.
Benz, H. E., p. 4.
Bradley, B. H., p. 3.
Brennan, A. H., & Dunlap, W. P., p. 5.
Brownell, W. A., & Watson, B., p. 6.
Brownell, W. A., p. 6.
Brueckner, L. J., p. 7.
Brueckner, L. J., p. 8.
Brumbaugh, D. K., p. 9.
Buswell, G. T., & John, L., p. 9.
Buswell, G. T., & Judd, C. H., p. 10.
Callahan, L. G., p. 4.
Capobianco, R. J., p. 12.
Capps, L. A., p. 5.
Cawley, J. F., & Fitzmaurice, A. M., p. 13.
Cohen, T. B., p. 10.
Cook, W. W., p. 15.
Cooke, D. H., p. 10.
Crenson, J., p. 16.
Dutton, W. H., p. 20.
Ebel, R. L., p. 20.
Edwards, R. P., et al., p. 15.
Epstein, M. G., p. 16.
Finley, C. J. p. 18.
Fuller, J. A., p. 19.
Glennon, V. J., & Wilson, J. W., p. 24.
Greenes, C. E., p. 25.
Guerriero, C. A., p. 25.
Heddens, J. W., Underhill, R., & Uprichard, A. E., p. 26.
Homan, D., p. 27.
Hopkins, M. H., 1978, p. 27.
Hopkins, M. H., 1977, p. 28.
Hynes, M. C., p. 28.
Kaliski, L., 1962, p. 31.
Krapp, R. P., p. 34.
Kraner, R. E., P. 33.
Kurtz, R., & Spiker, J., p. 23.
Lerner, J. W., p. 35.
Levy, W. K., p. 35.
Newport, J. F., p. 27.
O'Brien, K. G., & Boersman, F. J., p. 28.
Phillips, J., p. 39.
Potter, M., & Mallory, v., p. 40.
Robitaille, J. P., p. 33.
Romber, T. A., 1974, p. 42.
Ross, R., p. 34.
Ross, R. A., p. 34.
Ross, R. R., p. 43.
Savage, R. D., & O'Conner, D. J., p. 35.
Scheer, J. K., p. 45.
Schmitt, C., p. 36.
Schonell, F. J., p. 36.
Schwartz, A. N., p. 37.
Shaw, M. C., McCuen, J. T., p. 37.
Sovchik, R., & Heddens, J. W., p. 39.
Stenquist, J. R., p. 51.
Swize, L. M., p. 52.
Tarnopol, L., & Tarnopol, M., p. 52.
Thelen, H. A., p. 52.
Trueblood, C. R., p. 53.
Tyler, R. W., p. 53.
Uprichard, A. E., et al., p. 54.
Waugh, K. W., & Bush, W. J., p. 54.
Weidner, S. K., p. 55.
Whipple, G. M. (Ed.), p. 55.
Wilson, J. W., p. 56.

DIAGNOSIS – TESTS

Arthur, L. E., p. 1.
Ashlock, R. B., & Welch, R. C., p. 2.
Bowman, D. G., p. 5.
Brueckner, L. J., p. 7-8.
Caldwell, E., p. 10.
Carry, L. R., p. 6.
Chase, C. I., p. 8.
Connolly, A. J., p. 14.
Denmark, T., p. 16.
Driscoll, M. J., 1980, 2(2), 57-69, p. 18.
Dunlap, W. P., & Kalmey, A., p. 19.
Gardner, T. P., p. 23.
Gray, R. F., p. 25.
Gregory, J. W., p. 25.
McAloon, A., 1976, p. 36.
Maan, P. H., & Suiter, P., p. 36.
Monk, J. J., & Stallings, W., p. 25.
Monroe, W. S., p. 25.
Moore, E., & Platte, De. G., p. 25.
Peck, D. M., & Jencks, S. M., 1974, p. 29.
Rappaport, D., Gill, M. M., & Schafer, R., p. 40.
Rea, R. E., & Reys, R. E., p. 31.
Rimland, B., p. 33.
Romberg, T. A., Steitz, J., & Frayer, D. A., p. 42.
Romberg, T. A. (Ed.), p. 42.
Rush, R. R., Brown, J. A., & Delong, A. R., p. 35.
Sadowski, B. R., DAI, 1979, p. 44.
Sadowski, B. R., 1979, 1, p. 44.
Schminke, C. W., p. 36.
Shine, A., p. 38.
Smith, J. H., p. 38.
Smith, R. F., p. 49.
Smith, R. F., p. 39.
Wallace, G., & Larsen, S. C., p. 54.
Williams, R., p. 45.

GENDER DIFFERENCES

Burns, E., & Granito, D., p. 9.
Burton, G. M., p. 4.
Caplan, P. J., p. 5.
Gregory, M. K., p. 20.

REMEDIATION – CLASSROOM

Ashlock, R. B., p. 1.
Barcott, R. A., p. 2.
Beardslee, E., et al., p. 2.
Beatty, W. W., p. 3.
Ben-Jacob, M. G., p. 4.
Bradley, B. H., & Hunziak, M., p. 3.
Calhoun, T. M., p. 10.
Callahan, L. G., p. 4.
Cawley, J. F., & Goodman, J. O., p. 8.
Culea, J., p. 11.
Dahlke, R. M., p. 12.
Dahmus, M. E., p. 12.
D'Augustine, C. H., p. 12.
Devault, M. V., p. 13.
Denman, I., p. 13.
Doggett, M., p. 14.
Dougherty, F., p. 15.
Driscoll, M. J., 1980, 2(4), 67-78, p. 18.
Dunkley, M. E., p. 15.
Erickson, L. H., p. 16.
Felton, S. A., p. 17.
Fennema, E. H., p. 17.
Fennema, E. H., p. 18.
Green, R. A., p. 20.
Hutchings, B., p. 22.
Johnson, S. W., 1979, p. 29.
Jones, R. C., Maertins, N. W., & Hotchkiss, J. M., p. 30.
Jordan, J. H., p. 31.
Kephart, N., p. 32.
Kevra, B., Brey, R., & Schimmel, B., p. 32.
King, D. T., p. 33.
Kohn, M., p. 33.
Lane, G., p. 35.
Lazerick, B. E., & Harris, C. K., p. 23.
Lyon, L., p. 36.
McCully, R., p. 36.
Mary Jacqueline (Sister), p. 37.
Morton, R. L., p. 26.
Moskowitz, I., p. 26.
Nibbelink, W. H., p. 37.
Pinney, G. C., p. 30.
Quast, W. G., p. 31.
Rebec, L., p. 31.
Rees, H. E., p. 40.
Roseman, L., p. 43.
Ruais, R. A., p. 43.
Schilling, F., p. 45.
Schoen, H. L., p. 36.
Schumacher, D., Brown, F. E., & Dermott, A., p. 46.
Schwartz, F. J., p. 46.
Scott, A. W., p. 47.
Sharp, F. A., p. 47.
Shaw, C. N., p. 47.
Sherer, M. T., p. 47.
Simpson, P. A., p. 48.
Smith, M. C., p. 39.
Suydam, M. N., & Riedesel, A., p. 39.
Thornton, C. A., p. 53.
Turkett, A. K., & Purser, J. V., p. 41.
Vest, F., p. 42.
Weaver, J. F., 1954, p. 43.
Weill, B. F., p. 55.
Zweng, M. J., p. 46.

HIERARCHIES/SEQUENCING

Capie, W., & Jones, H., p. 5.
Cartwright, G. P., p. 7.
Caruson, J. L., & Resnick, L. B., p. 7.
Driscoll, M. J., 1980, 2(2), 47-56, p. 18.
Novillis, C. F., p. 27.
Novillis, C. F., p. 28.
Resnick, L. B., p. 32.
Underhill, R. G., p. 53.
White, R. T., p. 44.

MATHEMATICS LEARNING

Battista, M., p. 3.
Brownell, W. A., p. 3.
Ceci, S. J., & Peters, D. P., p. 13.
Copeland, R. W., p. 15.
Dienes, Z. P. p. 13.
Fleischner, J. E., & Frank, B., p. 22.
Glennon, V. J., 1965, 12(2), p. 24.
Glennon, V. J., 1965, 12(3), p. 24.
Shumway, R. J., p. 38.
Skemp, R. R., p. 48.
Weaver, J. F., 1972, p. 43.
Wittrock, M. C., p. 45.
Wittrock, M. C., & Cook, H., p. 45.

MISCELLANEOUS

Ashcraft, M. H., & Stazyk, E. H., p. 2.
Austin, J. D., p. 1.
Brownell, W. A., p. 3.
Brueckner, L. J., P. 6-8.
Burns, P. C., & Davis, A. R., p. 4.
Callahan, L. G., & Glennon, V. J., p. 11.
Callahan, L. G., & Passi, S. L., p. 5.
Carpenter, T. P., et al., p. 6.
Cathcart, W. G., & Liedtke, W., p. 7.
Cawley, J. F., & Goodman, J. O., p. 8.
Chandler, A. M., p. 8.
Chicorel, M., p. 14.
Cleveland, G. A., & Bosworth, D. L., p. 9.
Cobb, M. V., p. 9.
Cooper, C. R., & Petrosky, A., p. 10.
Denney, N. W., p. 13.
Driscoll, M. J., 1980, 2, p. 17.
Driscoll, M. J., 1980 2(4), 55-66, p. 17.
Driscoll, M. J., 1980 2(2), 71-77, p. 18.
Engelhart, J. M., 1976, p. 20.
Fishbein, H. D., et al., p. 18.
Glavin, J. P., & Annesley, F. R., p. 19.
Glennon, V. J., 1963, p. 24.
Hamilton, A., p. 20.
Hargis, C. H., p. 20.
Irons, J. L., 1975, p. 28.
Johnson, M., & Scriven, E., p. 22.
Kosc, L., p. 33.
Kurtz, V. R., p. 22.
Matulis, R. S., p. 37.
Mikelson, J. M., p. 24.
Minda, K., et al., p. 24.
Moore, R. C., & Ogletree, E. J., p. 25.
Murphy, L. B., p. 26.
Muscio, R. D., p. 26.
Paschal, B. J., p. 29.
Perl, T., p. 29.
Phillips, J., p. 30.
Pitts, R. J., p. 30.
Riedesel, D. A., & Pikaart, L., p. 32.
Riedesel, C. A., & Suydam, M. N., p. 33.
Roberge, J. J., p. 33.
Romberg, T. A., p. 34.
Rosskopf, M. F., p. 34.
Schwartz, R. H., & Shores, R. E., p. 37.
The Slow Learner, in Mathematics: Thirty-fifth Yearbook, p. 48.
Smith, L. T., & Bitter, G. G., p. 38.
Snellgrove, J. L., p. 49.
Suydam, M. N., & Riesdesel, A., p. 40.
Tyler, R., p. 41.
Uprichard, A. E., 1976, p. 54.
Vath, W. R., p. 42.
Wade, S. A., p. 42.
Watman, M. X., p. 42.
Weaver, J. G., p. 43.
Wilson, J. W., et al., p. 56.
Yant, S. L., p. 45.
Zoll, E. J., p. 46.

TEACHER TRAINING

Adams, S., Ellis, L., & Beeson, B. F., p. 1.
Burton, G. M., p. 9.
Callahan, L. G., 1973, p. 10.
Chinn, P. Z., p. 9.
Cohan, S. R., p. 9.
Cunningham, W. G., p. 11.
Davis, E. J., p. 13.
Dodd, C. A., Jones, G. A., & Lamb, C. E., p. 17.
Dutton, W. H., p. 15.
Engelhardt, J. M., & Weibe, J. H., 1978, p. 21.
Feinstein, I. K., p. 16.
Fennell, F., & Trueblood, C. R., p. 17.
Fey, J. T., p. 18.
Fowler, M. A., p. 23.
Fremont, H., p. 19.
Higgins, J. L., p. 21.
Howell, D., p. 22.
Irons, J. L., 1976, p. 29.
Krautheim, J. J., p. 34.
Oldaker, L. M., p. 38.
Reilly, V., p. 32.
Reisman, F. K., 1977, p. 40.
Reisman, F. K., 1972, p. 41.
Reys, R. E., p. 32.
Schultz, E. W., p. 36.
Schultz, K. A., & Strawderman, V. W., p. 46.
Tobin, A., & Bonner, J., p. 40.
Trueblood, C. R., p. 41.
Underhill, R. G., p. 42.

REMEDIATION – GENERAL

Aldridge, W. S., p. 1.
Austin, G., Rogers, R., & Walbesser, H., p. 1.
Behr, M., & Sowder, L., p. 3.
Berliner, D. C., p. 4.
Blankenship, W. L., p. 4.
Brueckner, L. J., p. 7-8.
Callahan, J. J., & Jacobson, R. S., p. 4.
Callahan, L. G., 1976, p. 11.
Campbell, P., p. 11.
Capps, L. R., p. 12.
Carlson, R. T., p. 12.
Carroll, C., p. 12.
Check, J. F., p. 13.
Cleaver, G., p. 14.
Cochran, C. E., p. 14.
Cohen, M. S., p. 14.
Connolly, A. J., p. 10. (MR)
Cruickshank, W. M., p. 11. (MR)
DeMars, R. J., p. 16.
Dickson, J. T., p. 13.
Doggett, M., p. 17.
Driscoll, M. J., 1980, 2(1), 25-30, p. 18.
Dunlap, W. P., p. 19.
Durall, E., p. 19.
Eichler, F., p. 20.
Engelhardt, J. M., 1974, p. 21.
Evans, R., p. 16.
Farnham-Diggory, S., p. 16.
Fennell, F. M., p. 22.
Fernald, G. M., p. 22.
Fincher, G. E., & Filmer, H. J., p. 1[illegible]
First National Conference on Remedial Mathematics, p. 22.
Flintner, P. F., p. 23.
Foti, F. T., p. 18.
Fullwood, H. L., p. 23.
Gemignani, M. C., p. 19.
Griggs, S. A., p. 20.
Heddens, J. W., & Hynes, M., p. 21.
Heimer, R. T., p. 27.
Hoel, L., p. 21.
Ingram, C. P., p. 28.
Johnson, J. O., Maertens, N. W., & Schooley, D. E., p. 22.
Johnson, S. W., 1979, 1, p. 30.
Jones, J. V., p. 30.
Jones, R. C., p. 30.
Kaliski, L., 1979, p. 31.
Lerner, S., p. 23.
Luke, H., & Trembley, P., p. 24.
Mayhall, W. F., & Jenkins, J. R., p. 24.
Neal, E. A., & Foster, I., p. 27.
Neuriter, P. R., p. 27.
Olsen, C. R., p. 38.
Otto, H. J., p. 29.
Otto, W., & Koenke, K., p. 38.
Peck, D. M., & Jencks, S. M., 1973, p. 29.
Peterson, D. L., p. 39.
Ramharter, H. K., Johnson, H. C., p. 31.
Riedesel, C. A., p. 41.
Rouda, E. M., p. 35.
Sauble, I., p. 35.
Scheer, J. K. p. 45.
School Mathematics Study Group, p. 45.
Steeves, J., p. 51.
Stromer, R., p. 39.
Swart, W. L., p. 40.
Tomlinson-Keasey, C., p. 53.
Trembley, L., & Lake, H. A., p. 40.
Weinstein, L., p. 44.
Weiss, S., 1973, p. 44.
Weiss, S., 1969, p. 44.
Whitecraft, L. H. p. 55.
Whitson, W. E., p. 45.